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AUTOMATIC DEVICES IN SMALL POWER PLANTS.

A prominent feature of most power plants of very large size and recent construction is the use of automatic devices facilitating the work of highly specialized employees in various departments of the station. The value of individual machine units is so great in very large stations that a company usually can afford to pay much more for insurance against mistakes and interruptions than an organization charged with smaller responsibilities. However, in the station of moderate size, the duties of each employee are usually so varied that the use of labor-saving devices of one kind and another is a very definite help toward smoother operation and more accurate service. By confining itself to devices which are low in initial and operating cost the small station may do much toward increasing the safety, economy and reliability of its service. The conditions of operation in small plants are almost always more variable in short periods than in large stations, taking the relative capacities of equipment into consideration, and hence it is a distinct benefit to introduce all inexpensive and reliable methods of securing smooth performance, which are consistent with simplicity of power-house service.

In many small stations the equipment is scattered about more than in the big plants, and it is less easy to see just what is going on than in the latter installations. The tendency in many cases is for the small plant to be more or less cut up with division walls, basement passages and partitions, illogical arrangements of apparatus, which are the outgrowth of early service conditions, cramped piping arrangements, differences in level between boiler and engine-room floors, rambling coal-storage and handling facilities, and often combinations of direct and belted apparatus which destroy any symmetry of operation. All these conditions—which, of course, do not appear to so large an extent in small plants of new design and construction—tend to increase the labor cost per unit of output. Thus, in six plants of small capacity examined lately, each of which was more or less handicapped by poor volume of output or the use of a number of small and relatively inefficient generating units, the cost of labor at the station per kilowatt-hour averaged 0.82 cents, with a range of from 0.41 cents to 2.10 cents. In stations of larger size, designed with direct-connected generating units and, as a rule, with auxiliary apparatus in close touch with the work

of the operating engineers, the labor cost ran nearer 0.25 to 0.30 cents per kilowatt-hour. It is quite possible that the introduction of automatic devices in a small station may not cut a single dollar off the payroll, and certainly will rarely enable the plant to be run by less men, but it will make it possible for the same number of men to perform more work and better work for a given expenditure, tending to reduce the total cost of operation per unit of energy by the more flexible handling of the machinery, the quicker adjustment of apparatus to load changes, and the prevention of excessive depreciation and heavier maintenance charges by the introduction of the proverbial "stitch in time."

Individual cases must determine the wisdom of installing recording voltmeters, ammeters, pressure-gauges, curve-drawing wattmeters, and thermometers in small stations, at least to any degree of multiplication. The use of watt-hour-meters on individual generating circuits, for instance, is much less important than the operation of a thoroughly reliable totalizing watt-hour-meter on the switchboard between the generating and feeder sections. In small plants where the cost of coal is at least $3 or $4 per ton, and upward, it will generally pay to install a flue-gas recorder. The use of a smoke recorder also may lead to more economical firing. The tendency in the past has been to spend too much money on electrical measuring and recording apparatus and too little on boiler-house equipment. Whatever may be the size of the station, there is no question about the desirability of installing automatic starting apparatus in connection with motor-driven pumps which supply circulating water to condenser suction wells, or which relieve sump-pits of accumulated drainage.

A reliable water supply is well worth all that it demands in the way of self-regulating equipment. Circuit-breaker alarms, low-water bell or whistle signals, extension bells on engine-room telephones, ignition indicators in gas-engine firing circuits, pilot lamps on switchboards and in some cases on auxiliaries, indicators showing the stage of water, momentary condition of steam pressure and voltage, counter devices on coal and ash-handling apparatus and other automatic apparatus of nominal cost in proportion to its usefulness, find a proper place in the small station, where it is yearly more important to know the quantities of fuel and water used, the temperatures and the outputs of the power-producing installation, if the plant is to be well managed.

Continuous records of these items will often bring to light possibilities of improvements which were not previously thought of, and lead to ultimate economies which are of really considerable importance in contributing to good management. Many a plant exists where the working conditions are positively unknown, and where a knowledge of them would cause genuine surprise to the men who are responsible for those conditions. A comparatively small expenditure may make this possible.

THE COMMERCIAL SECTION OF THE NATIONAL ELECTRIC LIGHT ASSOCIATION.

Considerable interest is being aroused through the energetic campaign which is being made to secure members of the Commercial Section of the National Electric Light Association. Membership in the Commercial Section is available to the employees of member companies of the National Electric Light Association upon the payment of a nominal sum. It is expected that many men whose interest in the electric-light industry has been confined mainly to commercial matters will eagerly avail themselves of the opportunity of thus becoming affiliated with the national association. While the Commercial Section is in a sense a departure, it is essentially but a development in the continually growing usefulness of the Association. Among the important matters which will be taken up for analysis and discussion by the Commercial Section are topics dealing with electric vehicles, industrial lighting, advertising functions of a sales department, improved wiring and equipment standards, electricity in rural districts, sign lighting, residence business, competitive illuminants and power. The work of enlisting new members in the Commercial Section is going along merrily and the interest is heightened by the presentation of a loving cup by Mr. J. Robert Crouse, chairman of the membership committee, for the member who secures the greatest number of accessions up to the time of the convening of the Association on May 29.

THE STATUS OF WIRELESS IN ENGLAND.

The successful result of the suit brought by the Marconi interests in England for patent infringement against their principal competitor in the field of wireless, as chronicled in our last issue, is likely to have an important bearing upon the future of wireless in that country, and possibly also in this. The patent involved is No. 7,777, issued in 1900, and is equivalent to the American patent No. 763, 772, issued in 1904. The principal claim of the patent covers the coupling of the oscillatory radiating circuit with a non-radiating spark circuit capable of carrying considerable energy, the one being tuned to the same frequency as the other.

The principal claim of the defense was that the patent was invalid on account of anticipation by Braun, but the court upheld the validity of the patent. Moreover, although the patent specified a two-coil air-core transformer, the court held that direct coupling or the use of an auto-transformer constituted infringement, inasmuch as the principle involved is essentially the same. At the time of the issuance of the patent, direct coupling had not been employed.

The result of the decision is to give to the Marconi Wireless Telegraph Company a practical monopoly in its field in Great Britain, for the period of four years remaining to the life of the patent, unless indeed the quenched

spark or the singing arc can be made practical for sending without the necessity of coupling two separate circuits for generating and radiating. The principal promise of these devices has been in the field of telephony, but there is room for the ingenuity of inventors in devising a complete system which will not infringe the patent rights protected by this decision.

What the result of a similar suit in this country would be is problematical. The immense possibilities which open from the interference of other patents and the different interpretations which might be put by an American court upon the ground covered by Mr. Marconi's claims, upon the equivalence of direct and indirect coupling and upon other questions of minor importance which are involved, render it impossible to forecast the outcome. One thing is certain, however, if the sweeping decision rendered in England were followed here, it would produce consternation among the various companies operating in competition with the Marconi system. And, moreover, the American patent would have longer to run. If such a suit were instituted it would undoubtedly be bitterly fought and would likely furnish litigation for a term of years, perhaps, like the fundamental Bell telephone patent, only reaching a conclusion near the time of expiration of the patent.

SPECIAL INCANDESCENT LIGHTING FOR BATTLESHIPS.

Since the earliest days of incandescent lighting the flexibility of this class of service has been its most attractive feature. Nowhere is this more apparent than in naval work, which is characterized by serious limitations of space, the necessity of quick control, and the important requirement of freedom from fire and explosion hazards. Few laymen realize the extent to which electricity is displacing oil lighting on battleships, a considerable number of special fixtures and lantern types having been lately developed for this service. In general the effort has been to secure a high degree of portability without sacrificing insulating conditions and the results show that electricity is decidedly superior to all other methods of illumination.

The problems of incandescent lighting on battleships are essentially mechanical in their nature once the proper insulation of the lamp leads is assured. The various services require the use of both plain and colored glass with both fixed and portable equipment. Considerable ingenuity has been manifested in securing water-tight designs, in providing against the excessive wear and breakage of leading-in conductors, in the arrangement of shields and guards to protect the lamp from mechanical shock, and in the installation of screens permitting the regulation of color and flash in accordance with the signaling or other service conditions. To meet the requirements of water protection, no less than eight types of rubber gaskets are now standard in naval service. Little novelty is presented by present designs of fixed lamp structures, except in the use of special equipment in coal-bunker service. For this work a cast-iron-box design has been developed, with the lamp secured behind a plate of glass one inch thick, the glass being, in turn, set behind four heavy vertical guard ribs which protect it from the coal. The fixture is put in place from the outside of the bunker, sets nearly flush with the wall, and enables the lamp to be replaced without entering the bunker or removing the front glass plate. Another bunker fixture is now in service in overhead lighting, and by its use more efficient illumination can be secured than by side lights, although its arrangement for installation within the bunker instead of through a bulkhead makes it necessary to remove the glass plate in replacing the lamp. In other fixed lighting equipment the principal change over former practice is in its adaptation to the use of steel, brass or flexible conduit, in place of moulding.

Various types of battle, deck, cargo, magazine, binnacle, diving, masthead, side, peak, range, signal, top, towing, truck and turret incandescent lanterns are in regular application today, and illustrate the ease and safety with which electricity can be adapted to the most exacting service requirements. Without taking up the features of each type in detail it is noteworthy that these requirements demand extremely rugged construction in fittings, the use of glass plates and lenses of first-class quality, the employment of reliable terminal connections, liberal use of stuffing boxes and glands, and the accurate fit of all parts. The latest type of portable electric lantern is fitted with a phosphor-bronze spring in the handle, ending in a brass casting fitted with a stuffing gland. This spring protects the insulation of the conductors and prevents chafing by avoiding sharp turns of the wiring where it enters the handle. The use of a hook on lamp guards is common to naval as to civilian service. The battle lantern is equipped with a movable shield by which the light may be completely shut off without opening the circuit, or else arranged to illuminate half a circumference. All parts are designed to withstand the most severe usage in night action around guns, ammunition hoists, and passages. The freedom from fire risk is a vitally important point. In the diving lantern the conductor is wrapped with iron wire for a short distance beyond the stuffing gland, to protect the insulation from breakage. Current is usually supplied by receptacles on each bow and quarter of the vessel, extra outlets being provided in long ships. Lamps of thirty-two candlepower are frequently employed in the heavier service, while five-candlepower bulbs are satisfactory for the smaller fields to be illuminated in connection with the dials of engine telegraphs, turret hood fixtures for telescopic sights, range finders, and other delicate apparatus. The extreme subdivisions possible with electric service are literally invaluable in handling equipment often forced by necessity into very limited quarters.

Canadian Association Appointments.

Eugene Creed, chairman of the Commercial Section of the Canadian Electrical Association, has made the following appointments of committee chairmen: W. F. Dean, Canadian General Electric Company, Toronto, Committee on Heating, Refrigeration and Kindred Appliance Sales; N. A. Braden, Westinghouse Company, Hamilton, Ont., Committee on the Functions of a Sales Department; L. W. Morden, Canadian Westinghouse Company, Toronto, Committee on Electric Vehicles; R. G. Black, Toronto Electric Light Company, Committee on Improved Wiring and Improved Standards; A. E. Fleming, Nernst Lamp Company., Toronto, Committee on Residence Business; A. M. Fisher, Electrical News, Toronto, Committee on Advertising; S. G. Redway, Toronto Electric Light Company, Toronto, Committee on Sign Lighting; F. A. Chisholm, St. Johns Electric Lighting Company, St. Johns, Que., Committee on Electricity in Rural Districts; H. G. Nichols, Factory Products, Limited, Toronto, Committee on Industrial Lighting; R. F. Pack, Toronto, Electric Light Company, Toronto, Committee on Membership; W. L. Bird, Kaministiquia Power Company, Fort William, Ont., Committee on Power; Thos. F. Kelley, Hamilton Electric Light & Power Company, Hamilton, Ont., Committee on Street Lighting; Edward H. Pike, Tungstolier Company, Toronto, Committee on Competitive Illuminants.

Telephone Taxation in Texas.

Through stringent taxation laws which were recently passed by the Legislature of Texas, that state has in five years fallen from the eighteenth state in telephone development to the twenty-eighth.

The assessed valuation of telephone properties in Texas for the year 1910 was about one-three-hundredths of the assessed valuation of all property in the state. The actual value of all telephone properties there is said by reliable authorities to be less than one-twenty-five-hundredth of the taxable property.

Under the law which provides for the taxation of telephone companies they must pay one and one-half per cent of their gross receipts, which amounts in many cases to ten per cent of the net earnings.

New York Public Lectures.

The Department of Education of New York City has announced several series of lectures on electricity, to be delivered in March and April.

In Manhattan, C. L. Harrington lectures on "Magnetism and Electricity," on Fridays at 320 East Twentieth Street; W. W. Ker lectures on "Principles and Practice in Electrical Engineering" on Thursdays at St. Luke's Hall.

In Queens, J. N. Gray lectures on Fridays on "Electricity" at Newtown High School; F. W. Huntington on "Electricity and Magnetism" on Mondays in Public School 88, Ridgewood Heights; W. W. Ker repeats his course on Wednesdays at Public School 58 in Woodhaven.

In Richmond F. W. Huntington repeats his course on Fridays at Public School 14, Stapleton. All lectures begin at 8:15 p. m.

A New Telephone Merger.

Negotiations were started recently by the Friendship Telephone Company of Syracuse, N. Y., representing the Bell interests, for the purchase of the Rochester Telephone Company, with independent and affiliated lines.

The Syracuse company has, it is reported, made an offer to purchase the outstanding stock and bonds of the Rochester Telephone (Home) Company, the Rochester, Syracuse and Utica Telephone Company, and the Utica Home Telephone Company, comprising the system of independent telephone lines operating in Rochester, Syracuse, Utica, Canandaigua, Brockport, Weedsport, Baldwinsville, Rome, Clinton, Herkimer, Ilion, Mohawk, Frankport, and surrounding territory.

The whole deal will involve an expenditure by the Bell interests of several millions.

Laboratory Aid.

The United States Civil Service Commission announces that on April 19-20 an examination will be held at the regular places to secure elegibles for the position of aid, qualified in chemistry, a vacancy being in the Pittsburg Laboratory, Bureau of Standards. Those interested should secure Form 1312 from the United States Civil Service Commission at Washington, D. C., or from the secretary of any board of examiners.

Chicago Special to Electrochemical Convention.

A special car will be run from Chicago to the convention of the American Electrochemical Society in New York City, leaving at 5 p. m. on April 4, and spending the following day at Niagara Falls, for visits to the many points of interest there. A delegation from the latter place will join the party, which is scheduled to arrive at New York early on the morning of April 6. The trip has been arranged by Secretary Mawin, of the Chicago Section, and members and guests from western points will get a reduced rate by joining this party. The route is over the Michigan Central and New York Central Railroads.

Association of Railway Electrical Engineers.

The semi-annual convention of the Association of Railway Electrical Engineers will be held in the Washington Terminal Station, Washington, D. C., June 16 and 17.

The annual convention of the Association will be held in Chicago, Ill., from November 6 to November 10. The convention will open with a reception on Monday evening, November 6. The entire nineteenth floor of the La Salle Hotel has been reserved for the meeting and for exhibits by members of the Railway Electrical Supply Manufacturers Association.

International Congress of Applied Chemistry.

The eighth International Congress of Applied Chemistry will be held in the United States in September, 1912. The opening session will be held in Washington, D. C., on September 4, and the following sessions in New York City. There will be a section on electrochemistry.

Any person having an interest in the Congress is eligible to membership. Applications must be accompanied by the fee of $5.00. The secretary of the Congress is Dr. B. C. Hesse, 25 Broad Street, New York, N. Y.

Substitute for Radium.

Prof. Otto Hahn, of Berlin, has discovered a substance called mesothorium, which is said to equal radium salts in radioactivity, being quite as effective and much cheaper. It is a by-product in the manufacture of gas-mantles, and ten grams per annum can be obtained.

W. S. Lee.

On another page of this issue we publish a rather lengthy extract from an address made by George Westinghouse on the occasion of the Southern Commercial Congress at Atlanta, Georgia. This Congress celebrates the physical recovery of the South and the address by Mr. Westinghouse had to do with the part played by electricity in the development of the Southland. During the course of his remarks, Mr. Westinghouse paid a high tribute to the men responsible for that great development called the Southern Power Company. This development was inaugurated by Dr. W. Gill Wylie of New York, and it is being carried out on a magnificent scale by the present proprietors of the enterprise.

It is safe to say that so far as the textile industry is concerned electricity has and will continue to have a tremendous importance in development. The Southern Power Company bids fair to become one of the greatest distributors of electrical energy in the world. The ramifications of this system, both with respect to sources of supply and network of distribution, are remarkable and the engineering features engendered in the design, construction and operation of the plants, are typical of an excellence of a very high degree.

The pioneer work in long-distance transmission discovered men fully capable to solve the difficult problems involved. Similarly the problems of controlling the flood waters of mighty rivers have found men equal to the task, and among those who have been most successful is the subject of this sketch, W. S. Lee, chief engineer of the Southern Power Company.

William States Lee was born in 1872, in Lancaster, South Carolina. His early education was received in the common schools of Anderson County and he received his technical education at the South Carolina Military Academy, graduating in 1894. For a short time he was an instructor in the graded schools in Anderson, later on taking up engineering work and being promoted from transit man to resident engineer of the Pickens Railway Company in a short time. He then became resident engineer of the Anderson Water, Light & Power Company, and during this association had charge of the construction of the Portman-Shoals hydroelectric installation on the Seneca River. The United States Government coast defense plans for Charleston Harbor was Mr. Lee's next undertaking. In October, 1898, he became resident engineer of the Columbus Power Company. This company's dam on the Chattahoochee River at Columbus, Ga., was completed late in 1900, and was subsequently carried away. This river is remarkable for the rapid rise of its floods and the work of reconstructing this dam and handling the flood gained for Mr. Lee an enviable reputation and inured him to experiences which later on enabled him to successfully achieve even greater distinction. New opportunities soon arose, and following the reconstruction of the dam at Columbus and the completion of the electrical installation, Mr. Lee became chief engineer of the Catawba Power Company, building a dam at India Hook Shoals near Rock Hill, S. C. The dam was completed in the spring of 1904. Very soon after the completion of the transmission line the entire output of this company was absorbed and this led to the formation of the larger interest represented by the Southern Power Company. This company purchased the Catawba Power Company and acquired large water power rights on the Catawba and Broad Rivers. Mr. Lee was made chief engineer of the company, becoming also one of the vice-presidents, where he combines very happily his great engineering skill and his command of executive detail and organization management.

WILLIAM S. LEE,
Chief Engineer, Southern Power Company.

Mr. Lee is a member of the American Institute of Electrical Engineers, American Society of Civil Engineers, and the American Society of Mechanical Engineers. He is president of the Engineering Association of the South, president of the Greater Charlotte Club, and president of the Commercial Club of Charlotte. He has always taken a keen interest in local civic developments and is esteemed a most valuable member of the community in which he lives.

Exposition in Norway.

Norway is to hold an exposition in 1914 to commemorate the centennial of its independence. The exposition will be at Christiania and one section will be devoted to machinery and electricity.

The Price of Platinum.

Platinum has now advanced in price to $43.00 an ounce, which is the highest figure it has ever reached. In 1905 pure platinum was as low as $18.50 per ounce with only a small demand for it at that price.

MINNESOTA ELECTRICAL ASSOCIATION.

AUSPICIOUS OPENING OF FOURTH ANNUAL CONVENTION.

The fourth annual convention of the Minnesota Electrical Association was opened in the St. Paul Hotel, St. Paul, Minn., on Tuesday morning, March 14, with President Robert W. Clark in the chair. The wisdom of the Association in revising its by-laws so as to admit as members central-station men from North and South Dakota was well attested to by the large attendance on hand at the opening sessions and the manner in which the first day's program was carried out is fair indication that the present convention will be the most successful so far held, both in point of attendance and interest manifested.

Due to the excellent efforts of President Clark and his assistants the program for the convention includes many noteworthy papers on timely and vital questions. Elaborate entertainment features have also been arranged for.

The opening business comprised the reading of the reports of various outstanding committees. These included committees on publicity, finance, membership, technical subjects and the report of the secretary-treasurer. All reported progress.

The president's address, which was delivered after the above-mentioned reports, was a comprehensive résumé of the present conditions in the central-station industry. The general improvements which have been evident during the past year are due, according to Mr. Clark, to the general adoption of the high-efficiency metallic-filament lamp, the introduction of new and improved current-consuming devices and the stronger co-operation which exists between the central-station man and the manufacturer. Mr. Clark said that the attitude of the public towards central stations is gradually but surely changing from antagonism to friendliness. This is due to the public generally becoming more familiar with the value and benefits of electricity and also to the publicity campaigns which so many of the companies are carrying on. Referring to the commercial end of the business, Mr. Clark said that commercial departments were now recognized as an established phase of the central-station business. He spoke fully of the developments in street lighting, window lighting, residence lighting, sign lighting, electric power, heating, refrigeration, electric vehicles, etc. Isolated plants were also considered and Mr. Clark said that the number of new structures contracting for central-station service showed that a decided movement is on foot for universal central-station service. Gas, gasoline and acetylene competition was also referred to and it was advocated that the members individually collect all data comparing the various illuminants—having no doubt that the evidence would point strongly in favor of electricity. The progress being made in regard to the construction of an electrical building on the State Fair grounds was described and further action advocated on the part of the next administration. In concluding, Mr. Clark spoke of impending regulation of public utility companies, stating that it is becoming a country-wide movement and that central-station men of Minnesota should use their influence in having a state commission, rather than local city commissions, established.

A paper entitled "Curb Lighting" was then presented by the author, Ludwig Kemper, of Albert Lea, Minn. This paper contained some interesting statistics on various forms of ornamental street lighting and is given herewith in abstract form.

CURB LIGHTING.

Curb lighting is probably more popular in the Widdle West than in any part of the United States. Where only a few years ago the first installation of ornamental posts was placed in operation in St. Paul, there are at the present time innumerable systems in operation in towns with population from 2,000 up. Mr. Kemper stated that all forms of illuminants are used, from the eight-candlepower carbon-filament incandescent lamp to the flaming-arc lamp, although the tungsten-filament lamp is the most generally used. Statistics given showed that the cost of installation runs from $15.50 per kilowatt demand for arches in Appleton, Wis., to $1,100 per kilowatt demand for three-lamp posts in Los Angeles, Cal., and that the annual gross income to the central station runs, per kilowatt demand from $56.83 to $408.33. The average cost of installation however, is $350 and the annual gross income per kilowatt demand $240.

Mr. Kemper stated that curb lighting is an attractive load for the central station to secure, not only for its large gross income, but also for its good load-factor and good rates. The load-factor ranges from 22.5 per cent for installations where all lamps burn to midnight only, to forty-five per cent where all lamps burn all night; and the rates range from three to ten cents per kilowatt-hour gross. Average conditions, however, are thirty per cent load-factor and five cents per kilowatt-hour net for current.

Other advantages for curb lighting mentioned by the speaker were the stipulation it gives to store, sign and window lighting. In connection with a method for increasing ornamental street-lighting business Mr. Kemper advocated the establishment of a committee, the functions of which should be the collection of data relative to this subject and the securing of lantern slides illustrating typical installations, this material to be the property of the Association and used wherever a campaign was in progress.

Secretary Gordon opened the discussion by asking for information relative to the installation cost of ornamental street lighting systems. Mr. Kemper said that in some cases the city pays for installation and in other cases the merchants or lighting companies pay, the city, however, generally agrees to take it over after a certain period.

In reply to questions by Henry Schroeder as to the average size of lamps used; usual schedule of burning and system of wiring, Mr. Kemper said that the sixty or 100-watt lamp was most commonly used; they usually burned until midnight and they were wired in multiple from underground circuits. He added that in most small cities the lights in the downtown district were on separate circuits with switches controlling all lights on a block.

J. B. Crane, of Duluth, described the ornamental street-lighting system in Duluth. The local commercial club secured all contracts and turned them over to the lighting company. Lighting contracts were made for one year and the posts were placed 100 feet apart, staggered.

R. W. Clark, of Minneapolis, presented some data on the installation in Minneapolis, stating that his experience has been that central-station men should discourage the movement to turn lights off before midnight, not so much on account of less current consumption as on account of the effect on the residents.

Morgan P. Ellis, of the Holophane Company, asked if the efficiency of the present standards was satisfactory. He then described an arrangement whereby greater efficiency can be obtained. Mr. Kemper replied that cleanliness was an important factor in ornamental street-lighting installations and that he did not approve of additional glassware, which would increase the work connected with cleaning. He added that attractiveness rather than efficiency was to be preferred. Mr. Ellis replied that no extra cleaning would be necessary. A report of succeeding sessions will be published next week.

An Interesting Montana Hydroelectric Project.

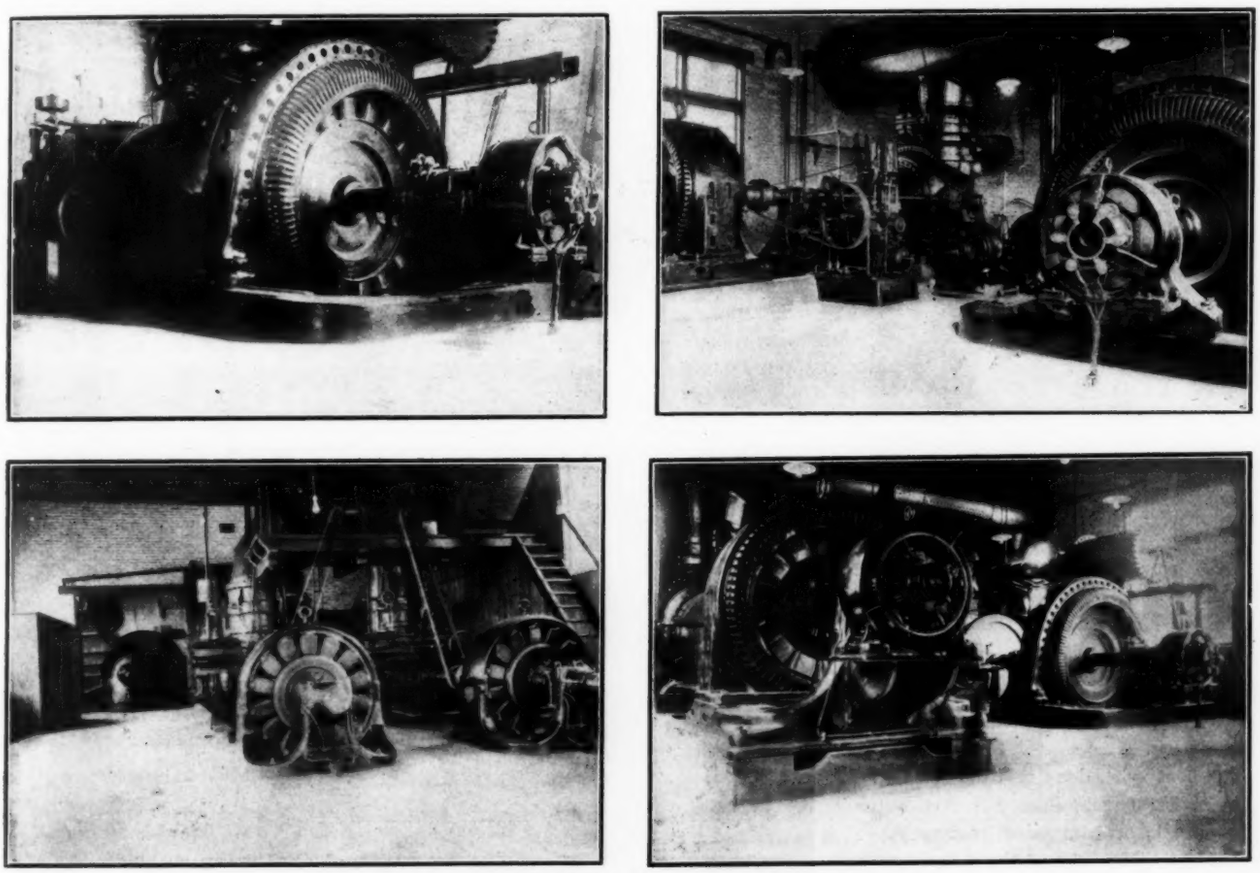
Development of the Northern Idaho & Montana Power Company's Big Fork Station.

Early in 1909 work was started on the reconstruction of the hydraulic end of the newly acquired Big Fork waterpower development of the Northern Idaho & Montana Power Company in Flathead County, Mont. This work, which is now nearing completion, has been unique in its character, as it necessitated the entire rebuilding of a diverting channel from the river to the power plant ,a distance of one mile, at the same time keeping the plant in operation.

The original project was completed about fourteen years ago by a local company, and after a period of operation of about nine years Howard Simmons & Company, of Chicago, purchased the property and immediately enlarged the station, adding an additonal generating unit and making various other improvements. After operating under the new management three years the plant was sold to the present owners, the Northern Idaho & Montana Power Company, one of the properties operated by H. M. Byllesby & Company, which operates an extensive transmission system in the states of Idaho, Montana and Washington. The latter company, realizing the promising future in store for the locality in which the properties are located, took immediate steps to reconstruct the hydraulic development in accordance with the best practice of today.

The Big Fork development is on the Big Fork River, which lies in a narrow valley between the Flathead and Mission Mountain ranges, in Flathead County, northwestern Montana. Practically the entire drainage area is within the Forest Reserve, and a large percentage of the flow originates in springs and from melting snows which lie on the mountains practically the year around. Some miles above the development the river flows into Swan Lake, which is approximately twelve miles long, and acts as a very valuable equalizer to the flow of the river. From this lake the river flows into Flathead Lake, and the last mile and a quarter of the river is a precipitate rapids. The power is developed at these rapids and a head of 115 feet is secured in a distance of one mile.

Before the Northern Idaho & Montana Power Company gained control of the property the water comprised a 1,500-foot length of wooden flume, an open-earth canal four feet deep extending from the end of the wooden flume a distance of 1,900 feet, 400 feet of earth flume, another 400 feet of earth canal and a length of 1,200 feet of wooden-stave pipe to the forebay. From the forebay to the turbines a steel penstock was carried down the quicksand side hill, at the foot of which the power plant is located.



FOUR INTERIOR VIEWS OF BIG FORK HYDROELECTRIC PLANT.

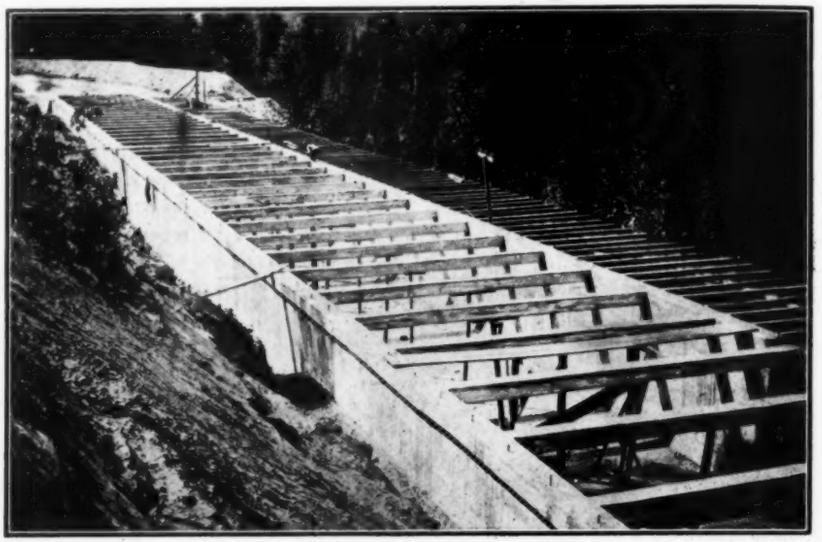
The reconstruction work embodied the changing over of the wooden flume to a reinforced concrete flume, the enlarging and strengthening of the earth canal, excavation for and installing 1,800 feet of nine-foot inside diameter stave pipe, and the building of a concrete dam across the river where its channel is diverged. The engineering features of this reconstruction of the waterways to the power house presented a number of difficulties on account of the local topographical and operating conditions. Inasmuch as the electric service of the entire Flathead valley was dependent upon this water power, it was necessary to make the development and operate the property at the same time. This fact, of course, had a strong bearing on the

WOOD STAVE PIPE.

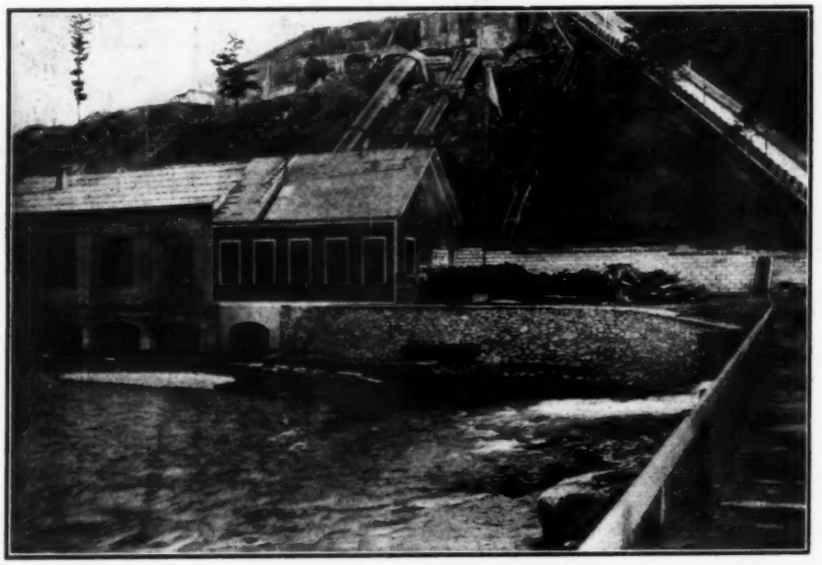
character of the re-development and greatly increased the difficulties and cost of the work.

The first work done was the construction of a concrete dam 237 feet long. The dam is of a massive gravity type, and while the height of the dam is only such as to raise the water six feet above its previous level, the character of the stream bed was such that it was necessary to go in places thirty feet below the stream to secure a suitable foundation. It was necessary to maintain the operation of the operating flume during this period and to provide for by-passing the water gate, so that a new concrete headgate could be constructed in place of the previous head-gates on the same side and still maintain water in the old flume below the dam. This work was carried out in the winter of 1909. All of the sand used in the concrete construction at the Big Fork development was obtained from the immediate vicinity, but in the majority of instances it was found necessary to excavate between boulders and then remove the clay, which invariably form a part of the deposit, by means of high-pressure apparatus. In connection with this difficulty it might be stated that, owing to the lack of railroad facilities, it was necessary to transport all machinery by ferry across Flathead Lake and then haul it by team to the site of the operations.

As previously stated, the section of wooden flume from the dam site to the earth canal was rebuilt as a reinforced concrete flume. In order to locate a new flume parallelling the old wooden flume, it was necessary to go into very extensive excavation, as the original development had taken the contour lines along the side hill, and it was deemed unwise to locate the new structure on the river side of the operating flume. For this reason a very large expense in excavation to accommodate the new concrete flume was involved. The original wooden flume was sixteen feet wide and carried four feet of water. It was decided to construct the new flume with an interior width of twenty-two feet and to carry eight feet of water, using the same bottom grade and securing the additional depth of water by means of the concrete dam previously constructed. The new flume was built twenty-two feet



NEW CONCRETE FLUME COMPLETED.



GENERAL VIEW OF POWER HOUSE.

wide inside, with walls ten feet high and ten inches thick. It is heavily reinforced and is tied together with 12 by 12-inch tie beams spaced at eight-foot centers. The forms for the flume were made up of angle-iron studding in sixteen-foot panels. The inner forms were set up with specially constructed braces resting on concrete blocks so as to raise them twelve inches above the ground surface and to the exact floor grade. The floor and wall reinforcement cages were then placed and other panels of the form placed in position and bolted to the inner form with suitable end gates.

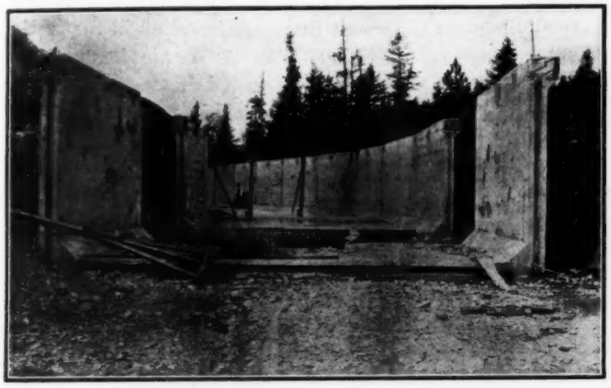
All of the form panels were handled from derricks resting on the old flume. In one of the accompanying illustrations is shown a section of the new concrete flume. The concrete was all poured at one pouring, including the flooring and full height of the walls, making a strictly one-piece casting of the flume. At intervals of fifty feet along the flume are placed copper expansion joints to take care of the changes of temperature.

In enlarging the earth canal unique methods had to be adopted, as the flow of water could not be interrupted. A channel was excavated parallel with the original channel and separated from it by a cofferdam. Sections of the new channel were then dammed and the cofferdam removed, thus allowing the stream to be widened, one section at a time. The reconstructed earth canal has sloping sides, the width of the channel at the bed being thirty feet and fifty-five feet at the surface of the water, and carries water of a depth of eight feet.

Below the first 1,900-foot length of the original earth canal the original development consisted of wooden flume, earth canal and additional wooden flume. Much of this flume was along the quicksand side hill previously mentioned, and in order to get away from the side hill it was determined to go back on a bench at a level fourteen feet above the old water surface and back about 200 feet from the slope of the hill, and excavate a new waterway. This involved a cut of about thirty feet, and this excavation was found to be largely in sand, and a hydraulic means of excavation was used. Centrifugal pumps were installed over the operating flume, supplying water through six-inch pipes to nozzles which were used as hydraulic giants to sluice out the excavation. Work was started at the lower end, where the cut opened up onto the side hill, and by means of sluice boxes the excavated material was sluiced down the slope.

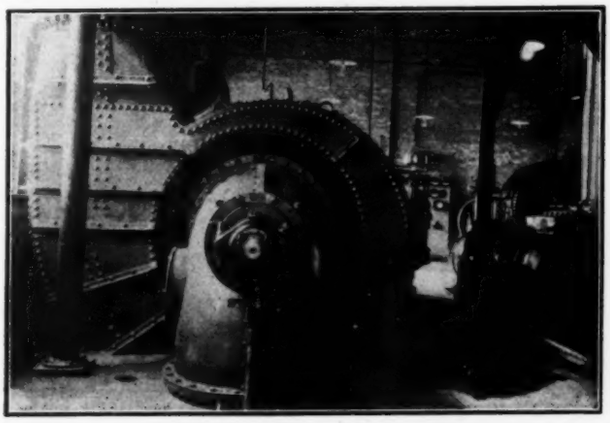
The original intention was to make the excavated waterway an earth canal, but a study of the excavation made this seem inadvisable, and it was finally decided to excavate to a lower grade and install a wooden stave pipe, to be so located that the top staves would be subject to a water pressure so as to be thoroughly saturated at all times, and after installation of the wooden stave pipe to backfill the cut so as to have three feet of earth over the top of the wooden pipe.

The concrete flume and the earth canal were designed for 900 second-feet at very conservative velocities, and it was decided to complete the development with two wooden stave pipes having an internal diameter of nine feet, installing initially one of these wooden stave pipes, but providing for a duplicate parallel pipe at a future date. In accordance with this plan the excavation was car-



FORMS OF NEW CONCRETE FLUME.

EXCAVATING FOR ENLARGED EARTH CANAL.



750-KILOWATT WATER TURBINE.

THE TWO NEW HEADGATES.

ried to the proper grade and one wooden stave pipe 1,800 feet long installed to complete the development. After completion of the installation of the pipe it was thoroughly tested and found to be thoroughly watertight, so that no danger could result from a surplus of leakage saturating the quicksand side hill and causing a slough off. The pipe was found to be exceedingly tight and it was backfilled, as previously indicated.

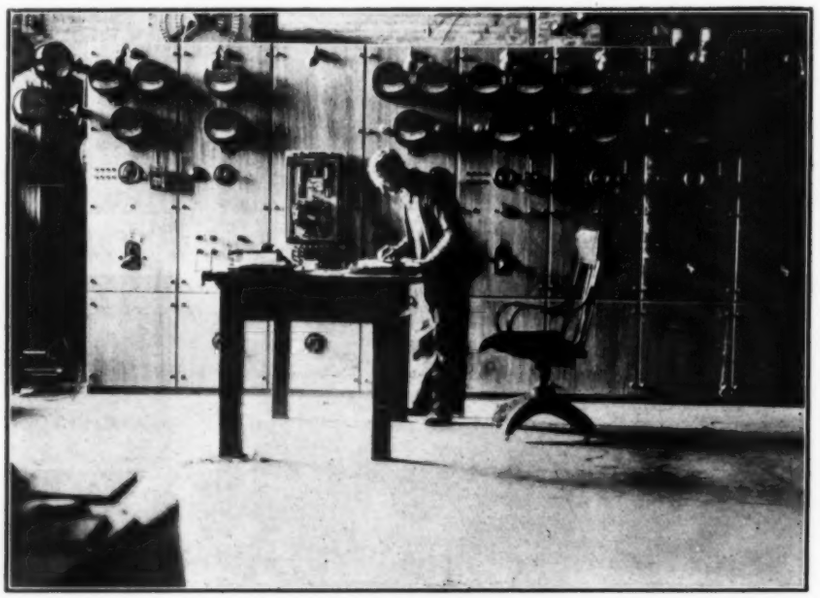
The excavation for this wooden stave pipe approximated 120,000 cubic yards. The wooden stave pipe was furnished by the Redwood Manufacturers' Company, and within its length two short radius steel bands were placed, which were manufactured by the Chicago Bridge & Iron Works. A portion of the wooden stave pipe was installed on a curve of 800-foot radius. The junction between the wooden stave pipe and the earth canal was a concrete structure designed to receive a spillway for canal regulation and for the handling of ice, and designed to receive two nine-foot wooden stave pipes. It was necessary to construct this structure in two stages in order to maintain operation on the wooden flume.

At the lower end the wooden stave pipe discharges into a large reinforced receiving basin constructed on solid rock, involving considerable rock excavation for its location. This structure was an addition to a smaller concrete receiving basin constructed under the supervision of H. M. Byllesby & Company in 1906. The enlarged basin provides for the ultimate capacity of the development, with penstock openings and racks designed for final installation of power house building and equipment to a capacity of ten to twelve thousand horsepower.

The water is regulated by spillway, a combined spillway and ice chute being built from the forebay to the tailrace. This spillway is seven feet wide and is built of wood, thoroughly protected. There are also spillways at two points between the forebay and dam to regulate the canal and care for ice.

From the forebay to the power house are run two steel penstocks, one seventy-two inches and one seventy-eight inches in diameter. The head available at the waterwheels is 110 feet. In one of the accompanying illustrations are shown the penstocks, power house and tailraces.

POLE-TYPE SUBSTATION.



MAIN SWITCHBOARD.

As may be seen the power house, a substantial structure, has been built in two sections, the original plant being on the left and the addition to the right. The generating equipment at present comprises two Leffel water wheels direct connected to two 180-kilowatt Westinghouse generators, one Trump turbine direct connected to a 500-kilowatt generator and one Allis-Chalmers scroll-case turbine direct connected to a 750-kilowatt generator. The latter unit is unique in having a substantial flywheel between the turbine and generator. The generators are wound for three-phase, 2,300-volt alternating current and are excited from direct-connected exciters. There is also installed a turbine driven fifty-kilowatt exciter unit. The turbines, with the exception of the Allis-Chalmers unit, are governed by means of Lombard governors. Views of several of the generating units are shown herewith.

The switchboard, which controls the current, also shown in one of the accompanying illustrations, consists of eight panels, comprising two exciter panels, four generator panels, two feeder panels, one of which supplies the step-up transformers. The current from the Big Fork station is transmitted to the surrounding towns, and for this reason the voltage is stepped up from 2,300 volts to 33,000 volts. For stepping up this current there are installed in the station three 300-kilowatt Westinghouse single-phase water-cooled transformers. The voltage is regulated by means of Tirrill regulators and protected from lightning by means of multi-gap lightning arresters.

The transmission system of the Northern Idaho & Montana Power Company's Big Fork plant comprises forty-six miles of high-tension lines. The towns served include Big Fork, Polson, Kalispell, Whitefish and Columbia Falls, the total population being approximately 15,000.

The main substation is located at Kalispell. This is a brick and reinforced concrete, modern, fireproof structure, and contains three 300-kilowatt transformers for reducing the voltage to 2,300 volts for local distribution. At Whitefish there is also a similar substation containing three 100-kilowatt transformers. At Columbia Falls and at numerous other settlements along the lines of the company, where conditions do not war-

rant the construction of a substation, a pole-type station containing three forty-kilowatt transformers mouned on one of the transmission poles is used. A view of one of these pole-type substations is shown in one of the accompanying illustrations.

The engineering of this development was done by the engineering department of H. M. Byllesby & Company, O. E. Osthoff, chief engineer, W. R. Thompson, assistant chief engineer, the hydraulic design being worked out by J. William Link, hydraulic engineer, and the work executed under the supervision of F. Y. Low, electrical engineer of the company, with William T. Walker as resident engineer.

Electrical Engineering Exhibition at London.

The third triennial Exhibition of Electrical Engineering and Machinery is to be held at Olympia, London, this year, from September 23 to October 21. It is to be international in character, and for that reason there have been sent for distribution through the Bureau of Manufactures, Washington, D. C., a number of circulars which set forth the nature of the proposed exhibition. It is said that this exhibition is in no way proprietary, but is a manufacturers' exhibition, promoted by the large electrical manufacturers of England, through their association, the National Electrical Manufacturers' Association. All the exhibiting firms will participate in the profits, if any, arising from the exhibition, although their liability is limited to their space rental, which is advertised not to be in excess of those of other exhibitions.

The forthcoming exhibition, it is stated, will be the largest event of the kind which has ever been held in England, and perhaps in any other country. The fact that this event will take place in the coronation year, it is urged, is also strongly in its favor, as there will be a large number of colonial buyers visiting in London, who will embrace the opportunity of visiting such an important undertaking.

It is suggested that if any manufacturers of the United States contemplate participating in this exhibition, it is important that they make inquiry early as to space, because a large percentage of the ground floor and a very large proportion of the galleries have already been engaged.

The Suit Against the Manufacturers of Incandescent Lamps.

As was announced in these columns last week, the Attorney-General of the United States on March 3, brought suit through United States District Attorney W. L. Day, in the United States Circuit Court for the Northern District of Ohio, at Cleveland, Ohio, against thirty-five electrical and other manufacturing companies alleging an unlawful combination and use of contracts in restraint of trade. The prayer and the petition are voluminous in scope and there are a great many allegations to which, in due course, the defendants will make fitting reply. The filing of the suit at Cleveland was unexpected, inasmuch as persistent rumors were abroad to the effect that the suit against the so-called electrical trust would be instituted along other lines and the case would probably be opened in Chicago. At the present time, except for a nominal statement by the General Electric Company, no word has been forthcoming from any of the parties at interest.

In the New Year's Number of the ELECTRICAL REVIEW AND WESTERN ELECTRICIAN, in compiling the statistics for the value of the electrical output in the United States in 1910, it was estimated that the value of incandescent lamps approximated $18,000,000. This vast industry is participated in by the General Electric Company, the member companies of the National Electric Lamp Association the Westinghouse Lamp Company, and a half dozen smaller organizations operating independently of any of these interests. The before-mentioned companies have for some time worked under a license arrangement, nominally in good faith, and the present suits it is expected will first of all determine to what extent the patent monopoly heretofore indulged in can be considered in restraint of trade in violation of the Sherman Act. Recently arrangements were made by which the General Electric Company, the National Electric Lamp Companies, and the Westinghouse Companies participated in joint research and laboratory work, resulting in the introduction of the Mazda lamp and developing to a great degree our present knowledge of the incandescent lamp.

The charges in the suit allege that in August, 1896, some of the defendants of the suit effected a combination to control the manufacture and sale of carbon lamps, the General Electric Company, Buckeye Electric Company, Bryan-Marsh Company, Columbia Incandescent Lamp Company and the Sunbeam Incandescent Lamp Company, organizing the Association of Licensed Lamp Manufacturers. The Adams-Bagnall Electric Company and the Perkins Electric Switch Manufacturing Company joined this organization, but the latter on retiring from the lamp business also relinquished membership in the organization. On May 3, 1901, another combination was formed at which time there had been a number of other accessions including the New York & Ohio Company, Davis Electrical Works, Shelby Electric Company, Fostoria Incandescent Lamp Company, Colonial Electric Company, Aylesworth & Jackson, Bernstein Electric Company, Munder Electric Company, General Incandescent Lamp Company, and the Warren Electric & Specialty Company.

The National Electric Lamp Company was incorporated on May 3, 1901, as a holding company, to include all members of the existing combination excepting the General Electric Company and the Westinghouse companies. The capital stock of the National Company was $650,000, consisting of $500,000 common and $150,000 preferred stock, together with an authorized issue of $2,000,000 in bonds. On December 14, 1908, the preferred stock of $150,000 was retired and the authorized issue of $500,000 common stock was increased to $2,500,000. Of the $2,000,000 increase $500,000 was issued January 18, 1909, to stockholders of the National Company in proportion to their holding of capital stock in that company, and $1,500,000 was issued on the same day to the same stockholders as a stock dividend and as a part of the accrued profits of the company. On July 1, the authorized issue of the capital stock was increased to $4,000,000, the $1,500,000 of the increase being issued to stockholders as a stock dividend and as a part of the accrued profits. On March 11, 1910, the authorized capital stock was increased to $5,000,000, the $1,000,000 increase being issued to the stockholders as a stock dividend from accrued profits. It is

also charged that the General Electric Company and the National Electric Lamp Company entered into unlawful agreements with the companies which the National Electric Lamp Company had failed to absorb, these agreements relating to the maintenance of prices on incandescent filament lamps, fixed and established by the General Electric Company and the National Electric Lamp Company and other controlling interests.

The charges imply that a manufacturer is debarred from purchasing patents enabling him to improve an article which he is manufacturing and establishing a nominal monoply of the articles produced under the use of the patent. The purchasing of the tungsten patents from the several manufacturers was principally for the purpose of obtaining the best material available for American lamp manufacture. The petition sets forth an unlawful acquisition by the General Electric Company and the National Electric Lamp Company of the foreign patents covering tantalum and tungsten-filament, and other filament lamps, relates the acquirement by the General Electric Company and the National Electric Lamp Company from the Siemens & Halske Company, of Germany, of the exclusive right to sell in the United States and its dependencies the tantalum-filament lamp under the patents of the German company. The consideration in this contract was a cash payment of $250,000. An agreement was made with the Auer Gesellschaft, of Berlin, Germany, whereby the General Electric Company on August 17, 1906, secured an option on the exclusive rights for the United States on tungsten-filament lamps, and all applications and inventions controlled by the Auer Company, the consideration being $100,000 cash and a lamp royalty on the manufactures and sales in the United States. From time to time the patents controlled by the Bergmann Electricity Works, by Sigmund Bergmann, of Berlin, Germany, and the patent applications and inventions for the Just-Hanaman and Küsel lamps have been acquired by the General Electric Company and the National Electric Lamp Company.

The companies named in the petition were announced in last week's issue and the specific charges embodied in a prayer to the court asking for action by order, adjudgment and decree are as follows:

1. That the defendants are, and for some time past have been, engaged in such unlawful agreements, combinations and conspiracies to restrain the trade and commerce among the several States and Territories of the United States in incandescent electric lamps, and to monopolize the same; and the court is asked perpetually to enjoin and restrain them from doing any act in pursuance of or for the purpose of carrying out the same.

2. That the association of "Incandescent Lamp Manufacturers" of 1896 was unlawful and a combination and conspiracy in restraint of interstate trade and commerce in incandescent electric lamps, in violation of the act of July 2, 1890.

3. That the National Electric Lamp Company is itself an unlawful combination in restraint of interstate trade and commerce in incandescent electric lamps; that it is now attempting to monopolize, is in combination and conspiracy with others to monopolize, and has monopolized, parts of such trade and commerce in violation of the act of July 2, 1890; and the court is asked that the National Electric Lamp Company be restrained from voting the stock of or receiving any dividends from the various defendant companies and corporations unlawfully acquired and controlled by it, and from exercising any control whatsoever over them.

4. That the shares of the capital stock of each and every one of the defendant companies or corporations acquired by the defendant National Electric Lamp Company were unlawfully acquired pursuant to said combination or conspiracy and are now unlawfully held; and it is asked that the issuing companies or corporations be enjoined from paying or permitting to be paid to the National Electric Lamp Company any dividends upon such stock.

5. That the shares of the capital stock of the defendant National Electric Lamp Company held by the defendant General Electric Company were unlawfully acquired and used by it and are now being unlawfully used by it; and it is asked that the General Electric Company be enjoined from further using or exercising the rights and powers incident to the shares so held by it as to bring about concert and co-operation between the National Electric Lamp Company and the other defendants or to obstruct trade and commerce in incandescent electric lamps or in such a way as to aid in the preservation of or attempt to secure a monopoly.

6. That the agreements between defendants General Electric Company, National Electric Lamp Company, Westinghouse Electric & Manufacturing Company and other defendants constitute and are contracts, combinations and conspiracies in restraint of trade and commerce in incandescent electric lamps, in violation of the provisions of said act of July 2, 1890; and it is prayed that the said defendants, parties to the said agreements, combinations and conspiracies, be enjoined perpetually from engaging therein, and from any like or similar agreements, combinations and conspiracies.

7. That the defendants General Electric Company and National Electric Lamp Company unlawfully, and in violation of the provisions of the said act of July 2, 1890, acquired and now hold the patents, applications and inventions covering the tantalum-filament and tungsten-filament incandescent electric lamps; that they were so acquired by said defendants for the purpose of suppressing all competition in the sale of such lamps in interstate commerce; that their acquisition by the defendants has resulted in restraining the trade and commerce among the several States and Territories of the United States in said incandescent electric lamps; and it is asked that they be restrained from exercising any such control over said patents, applications and inventions, or from so using the same as to suppress competition between said defendant companies and the other defendants, or others, or to obstruct trade and commerce in said incandescent electric lamps, or in such a way as to aid in the preservation of or attempt to secure a monopoly in the incandescent lamp trade.

8. That the contracts which the defendants General Electric Company, National Electric Lamp Company and its controlled companies have made and are now making with the dealers and jobbers who buy from said defendants the tantalum-filament and tungsten-filament lamps and are compelled to agree to buy all of their carbon-filament lamps from said defendants, are in restraint of interstate trade and commerce, and in violation of said act of July 2, 1890; and it is asked that the defendants be restrained and forbidden from enforcing or carrying out the provisions of said contracts, and from making with said dealers and jobbers or others any like or similar contracts, arrangements or agreements whereby the manufacture and sale of carbon-filament incandescent electric lamps in interstate commerce is restrained.

9. That the contracts which defendants General Electric Company, National Electric Lamp Company and its controlled companies have made and are now making with the defendants York Electric & Machine Company, Elmer F. Dwyer, doing business as Dwyer Machine Company, Corning Glass Works, the Fostoria Bulb & Bottle Company, the Libbey Glass Company, the Phœnix Glass Company and Providence Gas Burner Company were made for the purpose of furthering said unlawful combination, and with the effect of hindering and destroying the competition of independent lamp companies, and are contracts in restraint of interstate trade and commerce in violation of the aforesaid act of July 2, 1890; and it is prayed that the defendants be restrained and forbidden from so enforcing or so carrying out the provisions of said contracts as to obstruct trade and commerce in said incandescent electric lamps, or in such a way as to aid in the preservation of or attempt to secure a monopoly in the incandescent-lamp trade.

New Office of American Electric Railway Manufacturers' Association.

Announcement has been made by George Keegan, secretary of the American Electric Railway Manufacturers' Association, that offices have been opened at 165 Broadway, New York City. This will be the official headquarters of the Association, and out-of-town members are welcome to its use for receiving mail, etc.

Alderman Merriam Addresses Electric Club.

Prof. Charles E. Merriam, candidate for the mayoralty of Chicago, and now alderman, addressed the Electric Club of Chicago at the regular meeting on March 15, his topic being "Chicago and Its Needs of Today." H. H. Cudmore, of Cleveland, was also present and made a few remarks. It was decided to hold an informal smoker and vaudeville shortly.

ELECTRICITY IN THE DEVELOPMENT OF THE SOUTH.

AN ADDRESS BY GEORGE WESTINGHOUSE BEFORE THE SOUTHERN COMMERCIAL CONGRESS AT ATLANTA, GA., MARCH, 1911.

On the occasion of the Southern Commercial Congress, celebrating "The South's Physical Recovery," at Atlanta, Ga., on March 11, George Westinghouse delivered a stirring address on "Electricity in the Development of the South." In opening his address Mr. Westinghouse paid an eloquent tribute to the happy combination of the spiritual and intellectual qualities of the people of the Southland, and added "that the achievements of the South will be a source of pride to the North, will add to the luster of our country's fame, and strengthen its position among the great nations of the world. Continuing he said:

If we examine broadly the changes which have come about in industrial methods and in the means of transportation since the invention of the steam engine, it will be found that the application of power has been the fundamental factor in bringing about the characteristic conditions of the era in which we live. The steam vessel and the steam locomotive, by revolutionizing transportation methods, made possible the present development of our country. It is the power of the steam engine or the water-wheel which has substituted the power loom for the hand loom, with all the marvelous results which have followed. Similarly, throughout nearly every industry, human muscle is no longer the source of power, for the hand now directs and controls the untiring and unlimited power of great engines.

THE AGE OF ELECTRICITY.

Had a Jules Verne sought to imagine some universal servant of mankind, he would well have depicted some magic agent which would apply nature's forces to do man's work; which could take the energy of her hidden coal, of the air, or of her falling water, carry it by easy channels and cause it to give the light of a million candles, the power of a thousand men, or to move great loads faster than horses could travel, to produce heat without combustion, and to unlock chemical bonds and release new materials. No such wonder was pictured by the imagination of the seers of the past; and yet a subtle force which transcends the powers of the imagination is daily doing all these things—a vitalizing force, which is already stimulating the physical recovery of the South; and if we still think of the present as the era of steam and steel, unquestionably the coming epoch, whose dawn we are privileged to witness, will be known as the Age of Electricity. First the toy, and long the mystery of the scientist, electric power is now a familiar tool for the accomplishment of the work and the increase of the comfort and pleasure of mankind.

Mr. Westinghouse described the introduction and development of the static transformer and the alternating-current system of generating and distributing electrical energy, with which he was so prominently identified. The introduction of this system was opposed and it was sought to have laws made restricting its use as a menace to life and property. This incident was mentioned to present the possible harmful effects of restrictive legislation, as, had these laws been adopted, the art of transmitting electrical energy to great distances and at high efficiency would undoubtedly have been retarded.

As a result of the development of the alternating current and of years of experience in the manufacture of electric transformers and of insulators for supporting electric conductors, power is now successfully transmitted by alternating current over distances of two hundred miles or more. Thus water power in almost inaccessible places awaits only the coming of engineers and of capital to be made available for industrial purposes.

It is estimated by those who have made a study of the sources of water power of the Appalachian Mountains, that there can ultimately be developed from 5,000,000 to 7,000,000 horsepower during the dry season of the year, and a much larger quantity at other times. This great water power is brought by nature to your mountains and hills in widely varying quantities and will continue indefinitely; but the maximum and minimum flow of the waters of your rivers can be affected by the works of man and by a wise conservation of your forests.

Mr. Westinghouse dwelt upon the manifold uses of electricity, and its vital influence as a conservator of the natural resources of the country. He called attention to the leading part the South had taken in the development of hydroelectric enterprises and expressed high appreciation of the work of the Southern Power Company, begun by Dr. W. Gill Wylie and developed to its present stage by Messrs. Duke.

This is the largest power-transmission system in the South and is among the most extensive and important in the country. It is not a simple transmission line from a single power house to a single mill or city, but an extensive system which receives power from many power plants on different streams in several states. Hence, low water or high water on one river, which might temporarily disable certain plants, has but a slight effect on the whole system.

The lines of the Southern Power Company extend 150 miles north and south and 200 miles east and west, and connect into a single hydroelectric power system plants aggregating 100,000 horsepower. It is a magnificent demonstration of what electricity can do to conserve and utilize water power in developing the great and growing textile and other industries of the South. The Southern Power Company is furnishing light to forty-five cities and towns and supplying current to six street railway systems and to hundreds of motors for various uses. This power development is the result of intelligent and far-sighted business courage and confidence in southern affairs, which have inspired and actuated the men who have built up this great enterprise.

I am informed that the millions already invested in the Southern Power Company have not yielded even a moderate net income to those who have put their money into an investment which has benefited others more than themselves by insuring an increase in production and profit to its patrons, a striking evidence of the importance of a generous treatment by authorities as well as by those who derive an absolute money benefit.

The probabilities of development and utilization of electricity in various industries were dwelt upon briefly. Because of peculiar suitability, the industries most likely to expand are: textile mills, fertilizer works, cement plants, coal, iron, copper and gold mining, ore reduction plants, iron and steel mills, agricultural implement works, canning factories, road building, furniture manufacture, lumber plants, paper mills, shoe and leather factories, and oil refineries, in all of which industries electric power increases production.

Looking forward, Mr. Westinghouse predicted the increasing use of electrical energy in agriculture and horticulture and described briefly the experiments and deductions of Sir Oliver Lodge, with respect to the relation of electricity and plant growth.

The invention of the mercury-vapor lamp by Peter Cooper Hewitt, said Mr. Westinghouse, has led to the development of several other uses of the mercury-vapor arc, one of which is the production, in quartz tubes, of ultra-violet rays, the effects of which are likely to be of the very highest importance in our daily lives.

One of the important uses to which these ultra-violet rays have already been put has been to absolutely sterilize water, however much it may have been contaminated by bacteria. Experiments have also shown that the ultra-violet rays will sterilize milk without the application of heat in such a manner that it can be kept in properly sterilized vessels for long periods without deterioration or loss of its food values.

Not only have water and milk been sterilized, but in other experiments, also carried on at the Sorbonne, it was found that new wine was affected in a manner to give it the qualities normally attained in years, or an age of apparently many years was given by a few seconds' application of the ultra-violet rays.

These experiments and investigations suggest that uses for the ultra-violet rays will be found which have not yet been conceived.

The further development of mercury-vapor apparatus will add greatly to the possibilities of transmission of Hertzian waves, both for wireless telegraphy and telephony and for the wireless transmission of power.

A most important feature of Mr. Westinghouse's address was his vigorous utterances regarding the further development of our present resources.

The advantages of co-operation in the matter of the development and supply of electricity, having regard to a lessening of the cost and insuring the certainty of sup-

ply, cannot be overestimated, and those already secured by operations on a large scale are well known. Further co-operation in this great work for the benefit of the public, if not voluntary in the future, should, in my opinion, be an enforced one, notwithstanding the outcry which has been raised by the ill-informed with reference to an imaginary monopolization of the water power of the nation. Encouragement should be given to the investment of capital in the development of these enterprises under such wise and reasonable regulation as will insure economy in the construction and operation of plants, adequate returns to the capital invested, and at the same time protect the consumer against exorbitant rates and charges or unfair discrimination.

In the larger industrial developments which I foresee for the South there are other important factors which equal in importance the development of the water-power resources upon which I have dwelt. I have particularly in mind those existing restrictions which make it difficult and expensive for a small corporation to carry on conveniently and in a simple manner its business with ramifications in several states.

FEDERAL INCORPORATION.

I have long held that a federal incorporation act, which the President advocates, under which all companies doing an interstate business could organize, would be a solution of the difficulties which are now almost insurmountable, and which are being added to in an alarming manner in the endeavor of the legislatures of the several states to curb a few of the tens of thousands of companies and firms doing an interstate business.

PROTECTION OF MINORITY OWNERS.

After having read and carefully studied the bill providing for federal incorporation, which was introduced in the long session of the present Congress, I am constrained to say I would prefer to see a federal law in terms more easily comprehended by business men and devoid of those provisions which would give to a privileged few a practical control of a corporation by expedients which have been skilfully developed and which are now looked upon as a matter of course.

I have in mind particularly the depriving of minority owners of possible representation by the formation of voting trusts and the election of directors in classes, methods which can, and often do, defeat the purposes of laws which have provided for cumulative, whereby a substantial minority can insure the election of at least one member of a board of directors.

DIRECTORS SHOULD BE LARGE SHAREHOLDERS AND ELECTED ANNUALLY.

In my judgment, each director of a corporation should be required actually to own a substantial interest in the shares of the company, the affairs of which he aids to control, and the term of office be only from year to year. To make my meaning clearer, I will illustrate by supposing that a company had, by appropriate by-laws, established a board of five directors, only one of whom could be elected each year. Obviously, the provisions of the law for cumulative voting would have no meaning in the government of the affairs of such a company.

In conclusion Mr. Westinghouse urged the young men of the South to make themselves familiar with industrial affairs by learning to be proficient in the use of their hands as well as in the use of their heads, and recommended an adherence to the military spirit of discipline which requires readiness at all times to carry out the instructions of superior officers.

Roentgenological Impressions of a Journey in the United States.

Dr. G. Feodor Haenisch, of Hamburg, Germany, German Roentgen Society delegate to the recent Roentgen Congress at Detroit, has published in the December, 1910, *Fortschritte auf dem Gebiete der Roentgenstrahlen*, an interesting commentary on his observations in the United States. This article has been condensed in the February *Archives of the Roentgen Ray*, and we present some of these notes as follows:

During my tour I visited fifteen private laboratories of well-known roentgenologists, as well as hospitals and public institutes, some twenty-seven in all.

As far as my observations went there appeared on the whole to be no great difference in technique, but many roentgenologists who had visited Germany and Austria were of the opinion that the study of special branches was not carried out as thoroughly and so scientifically as in Europe.

Current meters and other accessory apparatus of foreign manufacture were only occasionally met with even in the larger institutes. But few German focus tubes were in use, and these were principally Müller tubes. I do not think that the American tubes are as good as the German ones, in spite of their higher price. I noticed that many even of the best known workers were obliged to regulate their tubes afresh for each exposure before they would work. Many operators expressed their regret that it was not possible to make habitual use of one of the German makes of tube. This is chiefly on account of the price, there being an import duty of 60 per cent on all foreign tubes; although there is in addition the disadvantage of being unable to exchange or replace an unsatisfactory tube at once if it is purchased abroad.

The Lumière and Cramer plates are much more used than German dry plates. These appear to be very good, but I was struck with the enormous thickness of the glass used for them. The demand for rapid or instantaneous exposure is very noticable, for which purpose the Snook apparatus and Waite and Bartlett's transformer are in great request. On the other hand, many induction coils and static machines are also used.

We were surprised to find how little use was made of roentgenoscopy. The unfortunate accidents which followed the excessive use of the fluorescope in the early days of roentgenology have brought radioscopy into disrepute, and only of late is this method beginning to be reintroduced, by certain practioners who have travelled in Europe and are convinced that for certain cases screen examination is absolutely essential. It is therefore not surprising that there is an almost total absence of American apparatus for roentgenoscopy, although a few German apparatus for this purpose are in use here and there.

The stereoscopic method, on the other hand, is widely used. In no single instance did I see a private laboratory which had not a more or less efficient apparatus for the making and the examination of stereoscopic plates.

In roentgen-therapy, which by the by is widely used and with astonishingly good results, I noticed an entire absence of any direct method of measurement. Here also I must except a few practioners who had studied in Europe.

In this connection I would mention the enormous advantage enjoyed by those American roentgenologists who are more or less able to keep up with the German literature on the subject. It seems a sad waste of talent and industry to have to rediscover facts which have already been well known for some years on the Continent. For instance, an eminent American roentgenologist showed me with pride an X-ray tube with a metal plate opposite the anticathode, with the aid of which he believed he had discovered the fact that the fluorescence of the glass was due to the cathode stream and not to the Roentgen rays,—a discovery which had been made years before by Walter of Hamburg.

In every institution the book-keeping and cataloguing and all the business arrangements are most excellently carried out. The register of plates is very carefully kept, usually by means of a card catalogue.

With a few noticeable exceptions, the equipment of the hospitals was far from satisfactory, and I can well understand the lamentations of my American colleagues. In many a large and fine hospital one or two underground cellar rooms were considered good enough for the Roentgen department, the housing of the apparatus, and the storage of the "pictures." One of the best known roentgenologists was recently dismissed because he had not "cured" any patient by his X-ray examination, although he had been doing all the work in this consumptive sanatorium of his own little town with his own private apparatus.

The honorarium for hospital work is in most cases very inadequate,—the amount given being nil, or a stipend which would be that of an assistant in Germany. It is difficult, however, to make a comparison. In America it is not usual for the surgeon or physician of a hospital to receive any remuneration for "charity work," and it would perhaps in some ways be better if the roentgenologist were to imitate them in this respect.

I spent more than a week in Philadelphia and saw the private work of Dr. Pfahler and Dr. Manges. Dr. Lester Leonard was unfortunately away from home at the Congresses of Brussels and Barcelona, so I had no opportunity of seeing his private institute. In Philadelphia I also visited the University of Pennsylvania Hospital (Dr. Pancoast), the Medico-chirurgical Hospital (Dr. Pfahler), the Jefferson Medical College Hospital (Dr. Manges), and the Philadelphia Hospital (Dr. Manges).

Dr. Pfahler works with a Snook apparatus of 4 kilowatts. He has also a coil and two large static machines. He is one of the few Americans who believe in the absolute necessity of Roentgenoscopic work. His apparatus for screen examination, with the patient standing, is the best and safest which I have as yet met with. The patient is situated behind a lead-lined door, which is provided with a rectangular diaphragm. The fluorescent screen is wound up and down with the focus tube and is protected by lead-glass. The window in the screen is also filled with lead-glass, so that there is no possibility of any secondary rays reaching the observer, who is, however, prevented from carrying on any manipulation of the patient during the examination.

The private institute of Dr. Manges was also well equipped. I admired more especially his stereoscopic plates. These were exhibited, as almost everywhere in America, by the Wheatstone apparatus, as made by Snook with adjustable mirrors. Dr. Manges also showed me his method of roentgenographic measurement of the pelvis, a method which he demonstrated later on to the Congress. The method is a stereoscopic one. Two metal clips are fixed immediately in front of the plate holder, so that their shadow will act as points of registration in the subsequent superimposition of the tracings. A stereoscopic pair of plates are made of the pelvis to be measured. The pair of points whose distance apart is required are marked in ink on both

plates, and a tracing of the two superimposed plates is then made. The tracing is placed on the original position of the plates, with the tracing of the shadow of the clamp in contact with the clamp itself. The position of the two points in space may now be reconstituted by the Mackenzie-Davidson cross-thread method, and the distance accurately measured. The method appears to me a perfectly practicable one, but if it is to be used in gynecology the necessary measurements would have to be made before the occurrence of gravidity.

The Roentgen Institute of the Pennsylvanian Hospital is a fine roomy building under the superintendence of Dr. Pancoast. The current is produced by a Snook transformer, which is installed in the examination room without any protection from the noise of the motor. Here I found in use the completely enclosed lead protection chamber, instead of the simple lead screen which was generally used. This chamber was lighted by an outside window in the wall, which is an advantage when the operator has to remain in it for long periods during treatment. Dr. Pancoast does not use the fluorescent screen, but he undertakes a good deal of Roentgen treatment, including irradiation for leukæmia and Hodgkin's disease. In leukæmia at the beginning of the treatment he irradiates the bones; and later on, when the spleen has begun to diminish in size, this organ also is irradiated. There too I saw the localisation of a steel splinter in the eye by means of Snook's improved Sweet-Bowen apparatus.

The Philadelphia Hospital and the Jefferson Medical College Hospital have very poor accommodation for their Roentgen laboratories, although the latter has been only lately rebuilt. Even Pfahler takes his 1,500 plates a year in the Medico-chirurgical Hospital in quite a small room, although he has a larger one for therapeutic treatment. He has an assistant and a German roentgen-sister from Immelmann's school of radiology.

I also visited the Roentgen Manufacturing Company in Philadelphia, under the friendly guidance of Mr. Snook, who is occupied in the designing of a new universal couch for steroscopic examination, both in the erect and the horizontal position, the change of plates and the displacement of the focus tube being carried out by automatic means. He showed me a practical improvement for the regulation of the tube, which could be carried out from a distance by means of a wire going from the positive pole of the coil to the regulating bulb of the focus tube. I may also notice a mechanical developing dish, in which the plate is not rocked but moved from side to side in the dish, and a dark-chamber lamp designed by Dr. Caldwell which allows the light to be turned away from the eyes of the operator.

At Baltimore I visited Dr. Baetjer's private laboratory, which he owns in conjunction with the orthopædist, Dr. Baer. I also saw Dr. Baetjer's department at the Johns Hopkins Hospital, where also was the special laboratory of Dr. K. Dunham of Cincinnati, who is carrying on a series of experiments on the radiography of the lungs. In the course of this investigation Dunham has made 150 stereoscopic skiagrams and over twenty-five autopsies. In taking the stereoscopic picture he displaces his focus tube in the direction of the axis of the body, as in this way he is able to see to a certain extent behind the ribs. In this case the patient must be in a horizontal position, which, however, is of no disadvantage. Dunham is of opinion that the appearance of arborisation in the lungs is given by the shadow of the bronchi as well as by that of the blood vessels.

In Detroit I also visited the private institute of Dr. C. Hickey, who was formerly a throat specialist, and his Roentgen department at Harper's Hospital. His switch board is in a small room between the two examination rooms, so that he is as completely protected as if he were in the lead sentry-box. The Snook transformer is in an adjacent room, so that the noise does not disturb the patient; this is the more important, as the American motor is even more noisy than ours. Like most other radiologists in this country, Dr. Hickey uses the compression screen of Kelly-Koett, which is not unlike Albers-Schönberg's. He does not practice radioscopy, although I noticed a Béclère stand at the Harper Hospital.

I saw Dr. Emil Beck of the North Chicago Hospital, who is well known for his injections of bismuth paste. He showed me some instructive skiagrams of injections in empyema, anal fistula, and tubercle of the spinal column.

Dr. Hornsby showed me the admirable Roentgen laboratory of the Michael Reese Hospital.

On my return journey I had the opportunity of visiting Dr. Henry Hulst of Grand Rapids, who is at the same time a general practioner and one of the most renowned of American roentgenologists. He is one of the first who introduced instantaneous exposure in lung examinations, and also one of the few Americans who practice systematic radioscopy. He has in his library a complete collection of the most important works on roentgenology. He uses an enormous static machine of 100 plates, of the Toepfer-Holtz system. This he prefers to the Snook transformer of five kilowatts, with which also he obtains instantaneous skiagrams. He uses Albers-Schönberg's focus tube box and chair, and Haenisch's trochoscope. Dr. Hulst is also radiographer to the Butterworth Hospital and the Grand Rapids Sanatorium for tuberculosis. In his hospital practice he uses a leaden sentry-box as a means of protection, but in his private laboratory he merely uses an arrangement of mirrors to watch the action of his focus tube.

The Boston City Hospital has a fine installation on the ground floor. I was unfortunately unable to see Dr. Francis Williams himself, who is so well known as one of the pioneers in medical roentgenology. The radiographic work is done by two assistant photographers. A very practical idea was a long gallery, on the windows of which the plates were exposed to view, each section of the hospital having its own division. For radioscopy Dr. Williams uses an enormous static machine, which is housed in a separate well-heated room. The treatment room was divided into a number of well-protected departments. No direct method of measurement was used. Of late Dr. Williams has given the preference to radium rather than to X-rays for radio-therapeutic treatment. The photographs exhibited on the walls show the most beautiful results in cases of epithelioma. In the systematically arranged plate catalogues a double system of cards enables the director to find any given plate with the briefest delay.

During the last week of my stay at New York I visited the private institutes of Dr. E. W. Caldwell, Dr. L. G. Cole, and Dr. L. Jaches. Unfortunately, I had no time to visit the New York hospitals.

Of all the institutes which I have visited, including the most renowned in Europe, Dr. Caldwell's holds the first place as regards the perfection of its technique. I have never before seen such a series of occipito-frontal views of the skull in which the sinuses with all their hollows are given with absolutely plastic effect, nor have I seen such abdominal pictures in which the kidneys on either side are depicted so wonderfully. Dr. Caldwell, who was formerly an engineer and only took up medicine after he had become a practical roentgenologist, has constructed almost all his apparatus in his own workshop. His technical inventive faculty is wonderful, but unfortunately he has not as yet published many of his ideas. He uses a Waite-Bartlett high-tension converter for his production of his current.

Like all American roentgenologists, Caldwell values stereoscopy very highly. His universal stand, which is made of wood and at first sight appears somewhat heavy, has stereoscopic attachments both for the tube and plate. A pressure on an indiarubber ball suffices to change the plate and to displace the focus tube at the same moment. The first exposed plate takes the place of the second plate, so that only one lead screen is required.

There is also an arrangement for taking a stereoscopic picture of the teeth and upper jaw. A glass tube containing a small celluloid capsule is introduced into the mouth. By a pull on a string the first film disappears into the tube and a second takes its place. The most beautiful part of the arrangement is the mounting of the film, so that none of its edges are covered.

Dr. Caldwell differs from most authorities as to the distance of the displacement of the focus tube in stereoscopic Roentgenography. Snook asserts that the focus-skin should be always the same, namely, thirty-nve centimeters and the stereoscopic displacement six and one-half centimeters. Caldwell, on the other hand, is of opinion—an opinion with which we agree—that for the same distance the smaller the object the greater should be the focus displacement, or what comes to the same thing, with larger bodies the focus-skin distance should be increased.

Another very practical addition to Caldwell's stand is a scale on which can be read any displacement of the focus tube, the focus-plate distance, and the angle of rotation when the patient is in the oblique position.

Among the various apparatus I must mention one for correct fixation of the patient in the examination of the nasal cavities. The patient lies on his back, and the head is held by a movable clamp which by means of a screen permits of adjustment of the head in all three directions. In taking the sinuses it is necessary to avoid the projection of the horizontal plate of the frontal bone on the frontal sinuses, as also that of the petrous bone on the antrum of Highmore, and the basilar process of the occiput on the ethmoid cells. To avoid this Caldwell recommends the following position. The focus-plate distance should be eighteen inches, and the normal ray should pass in the median plane through the glabella, making an angle of twenty-five degrees with the base of the skull, as determined by the glabella and the external meatus. He uses a short exposure with a hard tube whose vacuum and illumination he watches carefully during the exposure by means of a barium screen laid on the photographic plate.

Those of our readers who use an osmo-regulator will be interested in an arrangement by which the regeneration of the tube may be carried out from the protection of the lead sentry-box. A tiny spirit lamp is attached to the palladium tube of the focus bulb, and this is tilted so as to come in contact with the osmo-regulator by means of an indiarubber tube and ball. The lamp lights itself from the sparking of the circuit, and when the ball is released it is tilted back again by a spring under a metal hood which extinguishes it.

I was greatly surprised to find Caldwell an opponent of the tube diaphragm, which he considers useless. He has interested himself for some time in an apparatus for stereoscopic Roentgenography, and was the first to use a bicathodal tube for this purpose.

THE COST OF POWER.

DISCUSSION AT JOINT MEETING OF ELECTRICAL AND MECHANICAL ENGINEERS.

On March 10, a joint meeting of the American Institute of Electrical Engineers and the American Society of Mechanical Engineers was held in New York City, the subject for discussion being the cost of power.

The meeting was called to order by President Meier of the Mechanical Engineers, who called attention to the proposed New York legislation to license engineers, and to the united opposition of the engineering societies.

Secretary Pope of the Electrical Engineers made some announcements, including a list of the nominees who had been placed on the Directors' ticket, as follows: for president, Gano Dunn, 993, Ralph D. Mershon, 590; for vice-presidents, D. B. Rushmore, 536, C. W. Stone, 499, W. G. Carlton, 399; for managers, F. S. Hunting, 340, Farley Osgood, 245, N. W. Storer, 155, W. S. Lee, 109; for treasurer, G. A. Hamilton, 1294; for secretary, Ralph W. Pope, 1309.

President D. C. Jackson introduced the speakers, first calling attention to the importance of the subject under discussion and the diversity of views regarding it. The first paper was by John C. Parker and was entitled "Comments on Fixed Costs in Industrial Power Plants." An abstract follows.

FIXED COSTS IN INDUSTRIAL POWER PLANTS.

Mr. Parker's paper takes up several features of isolated-plant costs that bear no close relation to energy output. Of the fixed costs, the original investment is generally recognized by owners of plants, but a surprisingly large number of them include in this only the purchase cost of the machinery, neglecting entirely the cost of real estate, buildings, freightage and teaming, supervision of construction, and in some instances even labor of installation. The cost of insurance is sometimes overlooked in pre-estimating power cost. The interest on borrowed money for the installation of the plant is frequently underestimated. Many absurd ideas are held as to depreciation. Mr. Parker is in favor of taking different rates of depreciation for the different parts of plant equipment instead of an average rate. Obsolescence is not so important a charge in isolated as in central power plants. Supervision of the private plant is required and should be charged for. A fair profit on the plant investment should be charged against the power plant to correspond to the increased income that a similar investment in the main business of the enterprise would have secured. In an appendix to this paper Mr. Parker explains the meaning of marginal principle, showing that beyond a certain point a further investment may cause an actual burden on the project. In another appendix he gives some formulas for taking care of amortization. In the final appendix he gives comparative data for fixed costs on a plant where these amounted to over twenty-three per cent of the original investment. He also contrasts the total annual isolated-plant charges with those resulting from the purchase of central-station power and operation of only a heating plant; the latter gives a saving of about twenty-two per cent. In another plant using a producer-gas equipment he finds the fixed charges to be twenty-five per cent of the investment and that central-station power would have been over fifty per cent cheaper.

This was followed by a paper by Aldis E. Hibner on

COST OF INDUSTRIAL POWER.

Mr. Hibner makes some pertinent comparisons in his paper between the cost of isolated-plant power and central-station power. Manufacturers chronically overestimate the ratio of the power cost to the total cost of manufacture of their products; in many instances this is not more than two per cent. Those that have isolated plants generally underestimate the actual cost of their operation and maintenance. The manufacturer is frequently imposed on to put in an isolated plant by an unscrupulous salesman or unprofessional engineer, without giving proper consideration to the economy of central-station power. Before deciding on an isolated plant, the investment charges, the operating charges and the cost of heating by exhaust steam, must be duly weighed. The author shows a typical example of a shoe factory, giving in some detail the various estimated costs of a plain heating plant, a combined steam heating and power plant, and a gas-producer plant with a heating auxiliary. The last combination was found to be the most expensive, the steam plant next and the plain heating plant with central-station power the cheapest in the end. Conditions vary, however, and in some instances (with a heavy demand for steam) the steam plant would be the cheapest. In each case all the conditions must be considered.

A paper entitled "Notes on the Cost of Electrical Energy" was then read by John C. Parker, this paper having been prepared for the American Society of Mechanical Engineers.

COST OF ELECTRICAL ENERGY.

In this paper Mr. Parker makes a brief analysis of the cost of producing electrical energy, showing how it is based on three factors, a service charge, a demand charge, and an energy charge. An important bearing on the costs is the load-factor of the plant supplied. The diversity-factor enables a central station to supply non-coincident peak loads greatly in excess of what would be possible with only one class of service. Seasonal diversity should be encouraged, particularly heavy loads in summer, which might well be done by a reduced demand charge. Similar treatment should be accorded to consumers whose load is distinctively of an off-peak character. For equal costs of electric power by an isolated plant or a central station, the latter should certainly be preferred because of the reliability of the service, excellent voltage regulation, availability 8,760 hours per year, etc. In considering the use of exhaust steam from an isolated power plant for heating, it should be remembered that the maximum heating demand is seldom coincident with the maximum power demand and that the resulting economy of the arrangement is not what is anticipated. In an addendum Mr. Parker gives a series of typical load curves to show non-coincidence of peak loads and relation between summer and winter load curves.

N. T. Wilcox, chairman of the Industrial Power Committee of the Institute, then took the chair and opened the discussion by calling attention to the widespread lack of knowledge concerning power costs in industrial establishments and even in many central stations.

P. R. Moses criticized Mr. Parker's items of costs, and considered those items exaggerated which referred to interest on investment, taxation, insurance, rental of space, and inital cost of steam engines. The resultant cost of power was therefore also exaggerated.

D. B. Rushmore said that other things besides cost had to be considered in choosing the source of power for industrial establishments. Among these is continuity of service. Water power plants have been lacking in this requisite, but conditions are now greatly improved, and the superiority of electric drive points to a larger utilization of water power in the East.

R. P. Bolton agreed with the general conclusions of Mr. Parker, and substantiated his allowance for insurance. He considered the rate of compound interest used for the amortization of depreciation too high. He thought the load-factor used by Mr. Hibner too high. Results depend more upon the load-factor than upon anything else. The use of exhaust steam for heating is important, but the conditions vary exceedingly in different installations.

Arthur Williams criticized some of the elements of cost used by both authors. He thought larger depreciation should be allowed on gas-producer plants. He knew of no plant where a sum was yearly laid aside for depreciation and permitted to draw interest. He preferred an allowance of 7.5 per cent for depreciation in place of Mr. Parker's 2.63 per cent. A third element of depreciation, in addition to obsolescence and physical life, is the imminence of competing power at a cost not exceeding the cost of operating the private plant. Depreciation is then complete. Correcting Mr. Parker's figures, he arrives at seven cents per kilowatt-hour. He agreed with Mr. Bolton that engineers should estimate without regard to ultimate outcome, and if after designing a plant and estimating its cost, it is found best not to install it, the ex-

penditure of time and money should not be lost to the engineer. As regards operating cost, preliminary estimates allow 6 or 7 pounds of coal per kilowatt-hour, while actual figures from private plants, under working conditions, are about 15 pounds per kilowatt-hour. He gave three examples of buildings (office building, hospital and hotel) where the central station could supply all the power and heat required at a lower charge than the previous operating costs alone, regardless of fixed charges.

Parker H. Kemble thought Mr. Hibner's allowance of five per cent for profit too low, as inquiry among manufacturers showed that fifteen per cent was nearer the average. This figure would bring the cost up to 2.75 cents. His experience showed ten pounds of coal a conservative allowance. Superintendence should also be allowed, and the total cost will be over three cents. With the load-factor specified, a large central station would contract for three cents.

H. H. Edgerton cited a typical plant of 460-kilowatts capacity where the operating cost was 2.1 cents, interest and depreciation one cent, making a total cost of 3.1 cents per kilowatt-hour. (Pea coal at $4.20 per ton.)

C. M. Ripley stated that the Commonwealth Edison Company operates three isolated plants in basements, and he thought the same machinery could be depended upon by the owners of industrial plants.

George L. Fowler said it was impossible to determine in advance what the cost would be. He cited one instance where the coal consumption was 3.3 pounds and another where it was 50 pounds per horsepower-hour. The yearly cost ran from $20 to $150 and the average in the town considered was $89.

H. W. Peck discussed the different ways of allowing for depreciation and thought that obsolescence applied to a private plant, if engaged in competitive manufacturing. He called attention also to the fact that the peaks of the heating and power loads do not coincide, which lessens the economy of heating by exhaust steam.

R. H. Tillman said that every engineer, whether consulting, central-station or operating, should consider only giving the investor a plant which will give the greatest return on the investment. Interesting figures were given for three plants used in manufacturing fertilizer, and a hotel plant.

John H. Norris gave figures showing the economy of gas-engine operation, even in small sizes. Plant No. 1: 50 horsepower, direct-connected, natural gas, 11-hour service 300 days per year, load of 15 kilowatts; cost is 3.5 cents per kilowatt-hour. Plant No. 2: 25 horsepower and 20 horsepower, belted, natural gas, 16-hour service, full load; 2.0 cents per kilowatt-hour. Plant No. 3: 65 horsepower and 30 horsepower, illuminating gas at 80 cents, factory; 1.9 cents per kilowatt-hour. Plant No. 4: 100-kilowatt and 65-kilowatt generators on one engine, 11-hour service, city gas at 65 cents; 2.3 cents per kilowatt-hour. Plant No. 5: two 75-kilowatt and two 65-kilowatt generators, city gas at 65 cents; 1,9 cents per kilowatt-hour. Plant No. 6: 40 horsepower and two 18-kilowatt sets on country estate; 3.3 cents per kilowatt-hour. Plant No. 7: 15 kilowatts lighting and storage batteries; 3.8 cents per killowatt-hour. Plant No. 8: 35-horsepower producer, 28-horsepower engine, 24-hour service; 0.9 cents per kilowatt-hour. Plant No. 11: 400-horsepower double-acting tandem horizontal engine direct-connected to 200-ton ammonia compressor, 24-hour service, Illinois slack coal; 0.46 per horsepower-hour. Other producer plants gave 0.7, 0.9, 0.96, 0.5, 0.6 cents per kilowatt-hour.

W. S. Timmis gave figures for a power plant, consisting of two 150-kilowatt, one 100-kilowatt and one 50-kilowatt generators, all direct-connected, the larger units to compound engines. Cost of plant, including auxiliaries, $38,183; cost per kilowatt, $84.85. Cost of operation, including interest and depreciation, 4.1 cents per kilowatt-hour, with heating of building included. If this be deducted, the cost is 3.2 cents per kilowatt-hour.

Stonewall Tompkins gave figures for the power house of the Coney Island and Brooklyn Railroad. Excluding fixed charges, the cost is 0.61 cents per kilowatt-hour at the power house, with coal at $1.95 per ton. 3.56 pounds of coal per kilowatt-hour are used. Including substation expense, the cost delivered to the feeders is 0.77 cents per kilowatt-hour.

F. G. Gasche, R. Tschentscher and W. B. Jackson submitted written discussion. The former thought that allowance for depreciation was usually too low. Many industrial power plants are obsolete in ten years. Illustrations were given from steel mills. A charge should also be made for spare units. A mistake is often made in selecting too large units. The interest on amortization fund should be taken much lower than by Mr. Parker. Mr. Tschentscher discussed fixed charges and their relative importance to operating charges and also depreciation. Mr. Jackson discussed the various elements entering into cost and the difficulty of determining them. It is seldom that a mill superintendent knows how much power he is using.

Mr. Parker then closed the discussion and the meeting adjourned.

Crossing the St. Lawrence with High-Tension Lines.

The high-tension transmission lines of the Canadian Light & Power Company are to extend from St. Timothee, Que., to Montreal, a distance of about twenty-six miles. With the exception of certain points where greater height is required, these lines, consisting of eight cables, are to be carried on steel towers fifty-two feet high, spaced at intervals of 500 feet. The crossing at the St. Lawrence River was, by necessity, one of these special points. The river at this point is about 3,400 feet wide, the water at its deepest point being about thirty feet deep, with a current of seven to nine miles an hour. The crossing was made by means of erecting on each shore of the river two steel towers approximately 130 feet in height, and building at the center of the river two concrete piers extending about fifteen feet above water level, surmounted by a steel tower of 150 feet in height. The span of the cables from the Caughnawaga side to the river piers will be 1,600 feet, and that from the river tower to the Highlands shore approximately 1,800 feet.—*The Canadian Engineer.*

Toronto Section Meeting.

The meeting of the Toronto Section, National Electric Light Association, held on February 27, was devoted to a discussion of questions prepared by a special committee. President W. W. Freeman is expected to address the Section on March 29.

CENTRAL-STATION PRACTICE

Transmission—Interior Wiring

ELEMENTS OF POWER-STATION DESIGN—XXVII.

TYPICAL STEAM POWER PLANTS.—II.

BY W. B. GUMP.

Fig. 8 shows the interior view of the Fisk Street power station of the Chicago Edison Company, in which dry-vacuum pumps (of the piston type) are used. In this view the steam-driven centrifugal circulating pumps are plainly visible.

Fig. 9 shows a steam-turbine equipment with a Leblanc jet condenser and auxiliaries. This view portrays in a striking manner the simplicity of the connections and the absence of valves and cylinders. The driving power used may be either a steam turbine or electric motor. On account of the high speed required a cylinder engine is not feasible.

Cooling Towers—Cooling towers of the most common type consist of wooden structures of which Fig. 10 is a good example. Circulating water, coming from the condensers, is distributed over the top, and trickles down over a set of labyrinths composed of slats (screens are also used), and is collected in the basin below, to be returned to the condensers. The expense of a tower of this kind is comparatively small, and it gives good results. Its greatest disadvantage is the amount of space required. In this respect fan towers are superior. The chief objection to the latter type is the necessity of running fans continuously. This increases the maintenance, and in the event of an interruption to the fan interferes with the operation of the plant. Where space is limited, however, the fan type is generally to be favored.

Water Purification.—In order to prevent corrosion and incrustation in boilers, and in condensers as well, a number of methods of water purification have been devised. The fundamental process involved in practically all of the schemes used consists essentially of a series of filtering tanks or compartments by means of which scale-forming material is eliminated, before being allowed to pass to the boilers.

A water-purification plant is generally a costly adjunct, and its practicability in a particular case can be settled only by carefully investigating the local environment. A power plant which is located within close reach of an abundant supply of circulating water, and can operate condensing, is warranted in having a purification plant, if the boiler water is unfit for use without treatment. In this case the normal amount of water to be purified will constitute merely the make-up water which is small in quantity compared to that of a similar plant operating against atmospheric pressure.

A good example of the case just cited is to be seen at Redondo, Cal., where the power plant of the Pacific Light & Power Company utilizes ocean water for the surface condensers, and employs a purifier to handle boiler-feed water, which is of a bad quality.

The cost of water-purification plants varies between $1.50 and $6.00 per horsepower, depending upon the size of the station, and the operating requirements.

Steam-Plant Foundations.—Having selected the mechanical appliances which go to make up the typical steam-power plant, it is well to turn our attention to the matter of housing this apparatus, beginning with the foundation. The subject of power-plant foundations is indeed a broad one, and it is so interwoven with the other features of a plant, that its treatment here must of necessity be brief.

The advantage of locating a steam-power plant on a water-front is too well known to require any comment. The chief factor often tending to annihilate this advantage, when other factors are favorable, is the cost of construction. However, it is a question of first cost, and not of maintenance, since the structure may be regarded as permanent. With the plant at some remote point the cost of boiler and circulating water may be excessive, thus increasing the cost of operation to a prohibitive value, while the cost of transportation of fuel and supplies may also be unfavorable.

Where the river, lake or ocean is navigable for fuel transportation to points within reach of the proposed site, the cost of foundations is generally justified.

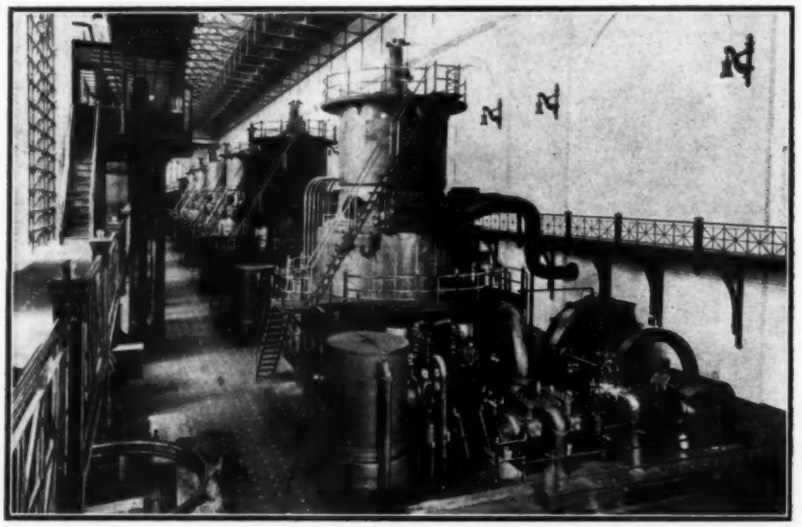


FIG. 8.—FISK STREET POWER HOUSE, COMMONWEALTH EDISON COMPANY.

The nature of foundations for steam-power plants varies widely, and depends almost entirely upon local surroundings. In every case, however, deep footings are necessary. This is true even of plants located upon bed rock, for the reason that the basement with its columns and tunnels, as well as the side walls, require considerable depth below the main floor, in order to support the enormous weights to which the material is subjected.

The best modern practice demands sheet piling for foundations in the vicinity of water fronts, such as those having sand or clay soil, or in the region of swamps and marshes. A location upon swampy land is rather unusual, and is terioration with its consequent weakening is inevitable. The tops should be joined permanently and effectively previous to a thorough application of concrete upon which the building is to rest.

It should be stated here that a large number of borings are required in cases where the nature of the soil is not definitely known. These borings should extend to a depth of from one hundred to several hundred feet, and the samples of the strata at different depths must be carefully noted in order to provide a suitable foundation.

The Superstructure.—First in importance in connection with the superstructure are the requirements of mechanical strength and rigidity; and second, the turbine may be placed upon any foundation which is capable of supporting its weight. With large reciprocating engines counterbalancing is not fully realized and the vibration is only partially allayed. This is accomplished by means of large foundation bolts extending into a massive substructure. Thus the cost of construction is higher for the reciprocating plant, and the cost of erection is considerably greater. In addition to these disadvantages is the excessive space taken up in the basement (as well as on the main floor), crowding the room for piping and auxiliaries.

The absence of vibration of steam turbines is well emphasized in the "double-deck" type of station, where vibra-

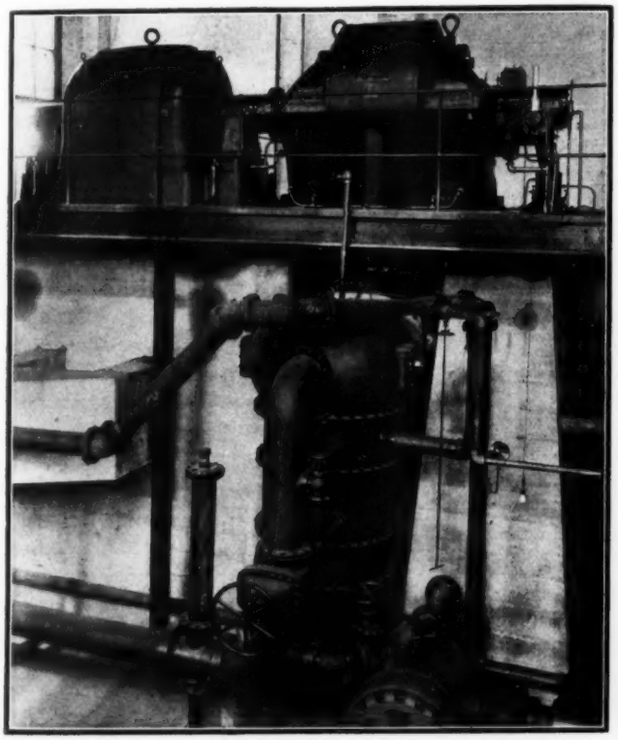


FIG. 9.—WESTINGHOUSE STEAM TURBINE WITH LEBLANC CONDENSER.

FIG. 10.—COOLING TOWER OF COLORADO SPRINGS ELECTRICAL COMPANY.

justified only when other factors outweigh the disadvantages of such a location.

Concrete piles are rapidly replacing wood, on account of their permanency and the latitude permissible in molding them into almost any desired shape. Piling for this purpose must be strongly reinforced. The character of the design and other details pertaining to this matter should be placed in the hands of an experienced concrete specialist, who has previously been engaged in similar work.

Wood piles may be used where they are permanently moist. Otherwise de-

architectural qualities which bring about harmony in the design, and present a pleasing appearance throughout.

The ideal foundations for the machinery, and for the building respectively, are so related that vibration is entirely absent. This clearly calls for massive construction and the use of material of first quality.

Respecting the question of vibration, it is evident that the adoption of reciprocating engines demands more rugged construction than is required by steam turbines. The advantage of the turbine in this respect is well defined. A steam

tion on the second floor is not to be tolerated.

The floors should be designed with a view of carrying the heaviest single piece of apparatus at any point remote from the machinery foundations. The usual construction is an arched floor using heavy I-beams, and steel, or reinforced-concrete columns. Under favorable conditions, concrete beams are practicable, but this construction is not usually suitable for floors which contain a large number of openings, and are more or less cut up. It must be remembered that concrete beams require a large

amount of space, and in basements this decreases head room which as a rule is exceedingly valuable. In fact, the tendency in the majority of stations is to crowd the basement to an extent which hampers operation, preventing accessibility to auxiliary appliances, and causing congestion of electric cables, switches and the like; thus promoting inefficiency and increasing the fire hazard; not to mention the continual danger to which the station attendants are exposed.

Light and Ventilation.—The question of providing light and ventilation in a steam-power plant involves difficulties which are not generally appreciated at the outset. The chief perplexities which present themselves in the way of providing natural light are due chiefly to the clash between the space occupied by the windows, and that demanded by station apparatus. The window spacing must necessarily be symmetrical, while the electrical or mechanical appliances should be arranged in a manner most convenient for operation. The spacing most suitable to operating requirements seldom corresponds to the spacing of the window openings.

There are several ways of overcoming the above-mentioned difficulties. One is to provide high and spacious windows regardless of symmetry with station apparatus, permitting the latter to be where the electrical or mechanical requirements place it. Another scheme is to construct a high operating gallery containing only the main switchboard, and locate all large apparatus, such as switches and bus structures, in the basement, or in a separate room. It will generally be found that one of these plans is feasible, and in a plant where one wall is completely unobstructed from without, the first method is almost certain to satisfy the local conditions, since it permits a great variety of arrangements within the station, without seriously opposing the effect of the windows.

In some power houses the windows in the end walls are depended upon for daylight. The side walls are blank paneled. Here the controlling switchboard, high-tension switch structures, and similar aparatus are completely removed from the generating room, affording maximum illumination.

If the walls and floor are of a light color, either white or a color approaching it, the illuminating effect is greatly augmented. This can be taken advantage of very profitably in plants where the number of windows must be restricted. In plants of this kind there is a good opportunity to add adornments such as white-tile floors and wainscoting which greatly improve the appearance, while adding to the illumination.

It may be said in concluding this topic that the interior finish of a power station deserves a great deal more attention than is usually given to it. American practice seems to stand for utility at the expense of practically all that relates to the esthetic side. When it is considered that mechanical engineering is one of the arts, it is lamentable that the features which go to make up the finishing touches of a work so important as a power station are partially or wholly lacking.

The problem of artificial illumination is not usually serious, and can be easily worked out for almost any layout of station apparatus. Arc lamps are desirable in large stations, for overhead illumination of the generator room, but concentration of light at any one point should be avoided. The ideal lighting system is one in which the light is diffused throughout, and does not cast dark shadows. Where arc lighting is used, the location of the lamps must be well chosen, and the number of lamps limited. Otherwise the effect desired will be diminished, or entirely destroyed.

Ventilation in a steam-power plant is often neglected, and more especially the boiler room than the engine room. The latter also is sadly slighted in many instances. It will be noticed in Fig. 1 that both the boiler room and engine room provide outlets for the heat at the louvres above. This form of construction is quite common, and it affords ample provision for proper ventilation when the design is made to accord with the requirements. Climatic conditions will have considerable influence upon the character of design to be adopted. For example, in Southern California the roof structure for a power station need be only sufficient for a covering. The wind load to be reckoned with is small. There is no snow load to be considered. Therefore there remain but two elements: the weight of roof necessary for a covering, and the weight of trusses required for supporting. The louvres may have permanently constructed openings where the change of temperature is comparatively small, and the only storm weather is rain. In cold climates where snow storms are frequent in winter ,and the summers are warm the outlets are generally arranged with movable windows which swing and may be manipulated from below, offering both light and ventilation. Ventilators in the form of metal hoods are very effective for controlling the outlet of heat.

The quantity of heat in the generator room will be from three to ten per cent of the generated output. The daily average will of course depend upon the load-factor. It is therefore evident that in a steam-power plant the problem is to dispose of the heat generated, and is a question of cooling, and not heating the plant.

Unlike a hydroelectric plant a steam plant generates heat from two sources: the steam side (the prime movers and accessories) and the electrical side. If this heat is allowed to accumulate it becomes almost intolerable for those working in the plant, even in the cold winter months.

The hydroelectric plant is operated by prime movers of a diversely different sort. In cold weather, particularly, the wheel cases and penstocks absorb the heat, and decrease the total heat far below that of a steam plant of similar output. The problem with the hydroelectric plant is to retain the heat rather than to eliminate it, when heating of the building is required.

Switches and Bus Structures.—For both small and medium-size plants the arrangement of switches and bus structures shown in Fig. 1 is good practice. Oil switches require continual care, and should be placed where they are accessible for inspection and repairs. The bus structure may well be placed in the basement and out of view, since it has no moving parts, and requires but very little inspection. With the operating gallery above the switches and the bus structure immediately below, the wiring is direct, and simple to construct, and its compactness affords convenience in operating.

The variety of arrangements afforded in combining switches with bus structures is far too extensive to lend itself to further treatment here.

Instrument Transformers.—Potential transformers may be placed above or below the bus structure, so long as they are accessible and are segregated from other apparatus.

Current transformers (as before mentioned) should be located as close to the

instruments as possible, to avoid long leads, and the likelihood of becoming deranged. These transformers should in all instances be placed in separate cells or compartments, and the instrument wiring to them should be lead through unexposed conduit. The same construction applies to potential transformers.

Power Transformers.—The location of power transformers was touched upon in a fomer chapter. The remarks applied more particularly to hydroelectric plants than to steam-electic plants. The type most common is the oil-insulated, water-cooled.

In large plants complete segregation of the transformers from all other apparatus is recommended. They may all be located in a separate room or building adjacent to the generating room, or may be contained in individual compartments on the main floor. Due consideration must be given to facilities for removing the transformers, without interference with neighboring apparatus. This may be done in one of two ways: (a) By means of a transfer truck. (b) By means of a crane. The advantage of the first scheme is that a crane may be eliminated, which reduces the head room below that required by the second method.

Where cooling water is limited a cooling tower is required. However, if the condensing plant utilizes a cooling tower, it may be practicable to combine this with the transformer cooling water instead of constructing a separate cooling system.

Field Rheostats.—Generator-field rheostats require considerable space, and are capable of evolving a large quantity of heat. These two conditions should be kept in mind, and proper provision made to accommodate them.

Where these rheostats can be located directly under the operating gallery, and can be manipulated by hand, this method is superior to remote control, since it is cheaper and simpler than the method employing motor-operated face plates.

Potential Regulators.—Potential regulators are required in steam-electric plants which employ a large number of local low-tension feeders which demand a constant voltage, such as is required on lighting circuits. Railway power plants do not contain potential regulators unless a portion of the load is distributed to a lighting or other constant-potential system in the vicinity of the plant. In plants using potential regulators it will generally be found convenient to locate them on the main floor, where it is handy to inspect their working, and give them immediate attention in case of trouble. There are numerous cases, however, where it is expedient to install these regulators below. Such procedure is followed where a large number of regulators is required, and the cable runs are apt to interfere with other appliances if these regulators are on the main floor.

Wiring and Cable Runs.—While a number of the chief items relating to power-station wiring were taken up before, it may be stated that so important a subject cannot be emphasized too strongly. However, the object here is to mention only the general features which relate to steam-electric plants.

Due to the fact that a steam-power plant generates a greater quantity of heat than a hydroelectric plant of the same rated capacity, the problem of maintaining a safe temperature on the electrical apparatus is serious. Hence, wiring tunnels and ducts should be located in places which may be kept as cool as possible, and where artificial ventilation is desirable it should be provided in a manner suitable to the specific operating conditions to be met.

It is a notable fact that the typical hydroelectric plant (which generates the lesser quantity of heat) is generally free from congested wiring or cramping of electrical apparatus, while the steam plant is often crowded far beyond a reasonable limit, and becomes overburdened with a complex system of wiring due to extensions which have not been given proper consideration. The final result is serious interference between steam and electrical apparatus which is quite apt to end in disaster.

The future demands of a steam-power development are likely, as a rule, to involve more uncertainty than is the case with hydroelectric development, in which the design as a whole is quite definitely planned at its inception. This being true, it is to be deplored that so many steam-power projects are slighted with respect to ultimate harmony in design, especially with reference to the space alotted to new apparatus.

(To be continued.)

[EDITOR'S NOTE.—This important series of articles was begun in the ELECTRICAL REVIEW AND WESTERN ELECTRICIAN, September 3, 1910, and will cover all points of design. The remaining chapters will consider Hydroelectric Plants, Contracts and Specifications, Organization and Finance.]

Corrosion of Condenser Tubes.

A committee has been appointed by the English Institute of Metals to investigate the causes of corrosion of condenser tubes. Serious losses are continually arising from the rapid wasting of condenser tubing, and, indeed, the suggestion has been made in some quarters that iron tubes should be used, and the construction of the condenser turned over to the boiler-maker. Whilst in some cases the origin of the trouble is easily detected, a vast number must be included in the unsatisfactory category of "mysterious." So far mere chemical analysis has not sufficed to distinguish with certainty a tube which will prove satisfactory in practice, and, indeed, instances are many in which tubes having shown excellent resistance to corrosion in one locality have rapidly given out when the ship has changed station, and water of a somewhat different character has in consequence been supplied to the circulating pump. The tendency to adopt thinner tubes, and thus reduce the weight of the condenser, has aggravated the trouble, and, as matters stand, the existing lacunæ in our knowledge as to the causes and cure of corrosion involve heavy annual losses. The subject is, in fact, quite as important to commerce and engineering as it is of interest on the purely scientific side. Undoubtedly, much important work has already been accomplished, and the electrolytic theory of corrosion has provided an important clue, which, if followed up, will almost certainly lead to conclusions of the greatest practical importance.—*Engineering.*

Special Illumination for the Coronation.

Arrangements are already being made in many English cities, particularly London, to produce some strikingly beautiful effects in special illumination in honor of the coronation of King George V. Naturally this will be almost exclusively electric lighting.

Western Electric Company.

The business of the Western Electric Company for February is twenty per cent larger than for the same month in 1910, and is a record for that month. On the basis of the first two months of the year, gross sales for 1911 should be about $71,000,000, setting a new high record.

ELECTRIC LIGHTING and ILLUMINATING ENGINEERING

INCREASING USE OF DIMMERS.

PARTICULARLY ADAPTED FOR USE IN THEATERS, HALLS AND CHURCHES.

During the past year or so a great deal of attention has been paid to the subject of illuminating engineering with results that have so far been very encouraging. Many advances have been made in the types of lamps, reflectors and arrangements of illuminating systems.

Besides the problem of securing the most pleasing effects, proper distribution, etc., there is also the problem of getting variations in the intensity of illumination which is very desirable in many cases. This subject has been confined formerly to the large theaters and halls of the larger cities, but recently the advantageous results secured by subtle lighting effects, obtained through the control of diminishing and increasing the brilliancy of the lights, have been recognized more generally.

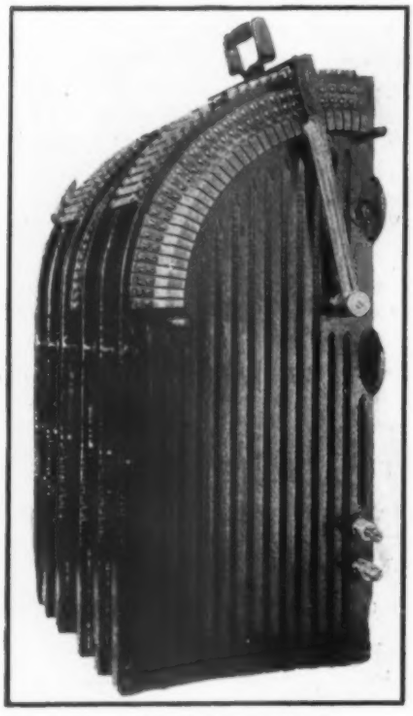


FIG. 1.—OLD-STYLE DIMMER.

The small theaters, many of which are springing up in all parts of the country, churches, fraternal temples, auditoriums, halls, etc., offer a wide field for the use of dimming equipments in connection with the lighting systems. Before the universal application of electricity for the illumination of theaters, gas was used and the variations in brilliancy were secured by means of turning a valve. But this method did not allow of many combinations, such as dimming of some portions and brightening of others, etc., and the gas was dangerous from a fire-hazard standpoint due to the open flame.

Early electric stage lighting was not much better because the variations in illumination were secured by cutting in and out various lamps, each lamp either giving its total candlepower or else being totally extinguished. Gradual dimming or brightening of the illumination of the stage was impossible, such effects as sunset being made in several successive steps, not exactly like the gradual decrease of light in a real sunset.

The dimmer was soon devised consisting of resistances which were made up into units inserted in series with the lighting circuits. First practice was to use large units placing between 100 and 150 lamps on the same circuit. An old-time bank of iron-clad dimmers is shown in Fig. 1. A large number of lamps on a circuit does not allow of the best effects so that during recent years dimmer plates have been made in smaller individual capacities and fewer lamps are placed on each circuit so that a much finer control of the variations in illumination is possible and realistic effects can be produced.

One common type of dimmer plate widely used is capable of controlling any specified number of sixteen-candlepower ordinary carbon-filament lamps from one to fifty per plate. There are now, also, dimmers made especially for use with tungsten lamps and small plates for use in residences. The resistance dimmer can be used on either alternating current or direct current and though there is a small loss in this method, such convenience is provided that this overcomes all objections

Dimmer banks for theaters or for controlling any large number of lamps consist of numbers of dimmer plates which are assembled for convenience in groups or rows. The method of operating can be by means of individual levers for each plate with a master lever for a group or by both these methods. The master lever allows control of numbers of plates in unison so that all lights of a certain kind, in certain locations, or of certain colors can be dimmed or brightened together. Non-interlocking dimmers do not allow this; each must be operated separately.

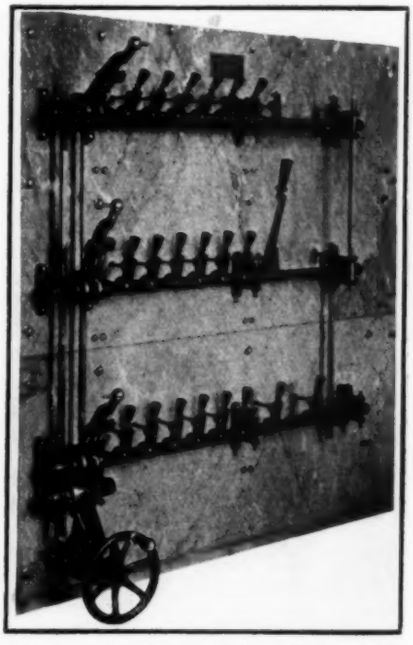


FIG 2.—WHEEL DRIVE FOR DIMMER BANK.

When a dimmer is desired simply for the purpose of controlling a number of separate lighting circuits all equipped with uncolored lamps as in a

small hall, church, etc., the non-interlocking type of dimmer, in which each plate is individually operated by its lever, is satisfactory. But where varied and extensive lighting effects are desired interlocking dimmers enable the securing of gradual changes and blendings. For instance, if it is desired to partially brighten the lights or sections of lamps of the same color, and after a few moments bring all lamps of that color up to normal candlepower, the interlocking dimmers will readily accomplish this in the following manner: First the individual plate levers are operated to brighten the lamps desired, then when the others should be brightened, the master lever operates all plates except those first operated; these will not be interlocked. But when the master lever brings all the second set of plates to the same position as the first, the entire number

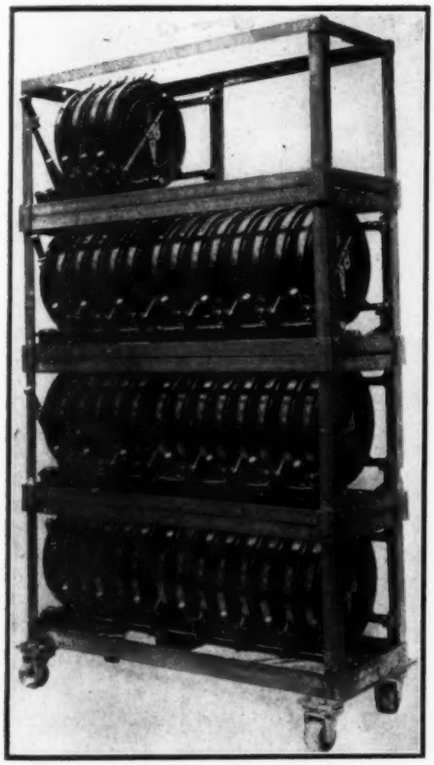


FIG. 3.—PORTABLE DIMMER.

will from there on be operated together by means of the master lever.

Still another refinement is sometimes added, that of wheel drive as illustrated in Fig. 2. This makes it possible to dim some lamps and brighten others at the same time. The wheel drive also gives a slow smooth motion and gives variations by almost imperceptible degrees.

In an equipment such as shown in Fig. 2, there are single-plate levers, levers for the control of any row, a master lever for all rows and the wheel drive. Turning the handle of any lever throws the plate or row into or out of interlock.

For some classes of work special dimming apparatus is built in which ordinary dimmer plates or units are not used. Resistance plates and other resistance units are used with special means for cutting these resistances in and out of circuit in desired steps.

Dimmer plates are used to the greatest extent as they are standard devices and are least expensive. Also the methods of arranging in groups and installing have been carefully worked out. These plates are sometimes arranged for mounting on front of a switchboard and also for mounting in rear of board, in which case the operating levers alone are mounted on the front of the board for operation. Special arrangements are also used in some installations, such as wall mounting, floor mounting, etc.

The "Simplicity" dimmer plate shown in Fig. 4 consists of a circular piece of soapstone on which the resis-

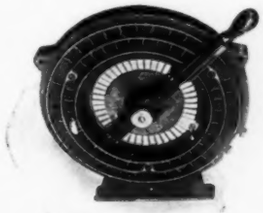


FIG. 4.—SIMPLICITY DIMMER PLATE.

tance, contact segments and terminals are mounted. The resistance is inclosed by a moisture-proof and fireproof special cement and the unit entirely incased in an enameled cast-iron cover. The contact lever is operated by a rigid driving rod making successive contacts with the segments.

Portable dimmers are sometimes carried by large theatrical companies where the illuminating and scenic effects are vitally important in the presentation. Fig. 3 shows a portable dimmer made up of four sections to facilitate shipment, used by the Metropolitan Opera Company. These sections can be placed in any arrangement desired. Fig. 5 shows the large automatic dimmer board installed in the New York Hippodrome.

It is the church, however, that has, up to recent years, received practically no attention in regard to illumination. Electricity is better adapted than any other illuminant to serve the needs of religious services and can best be made to conform and blend with the prevailing styles of church architecture and decoration. To this field also is the dimmer properly an important adjunct. The variations of intensity of illumination are just as necessary in the church as in the theater. The lighting effects as for different occasions, weddings, funerals, and for different parts of these and regular services, lend greatly to the impressiveness. By varying the resistance in circuit, variations in illumination in various parts of the church at desired intervals

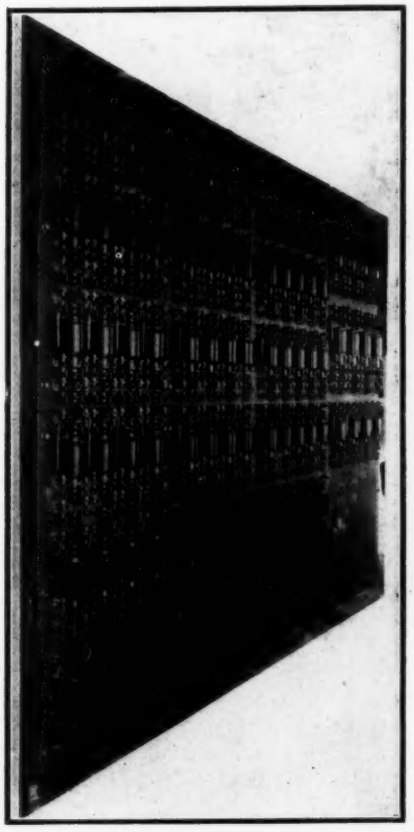


FIG. 5.—FRONT OF DIMMER PANELS, NEW YORK HIPPODROME.

can easily be obtained and most appropriate illuminating effects produced.

The St. George's Military Church, at Aldershot, England, has recently installed dimmers for this purpose and now one of the largest churches in this country has also installed a remarkably elaborate system of illumination and dimmer equipment. This church, which has been building for a score of years,

is the Protestant Episcopal Cathedral of St. John the Divine, Morningside Heights, New York City. The lighting of this church will probably be superior to any other in the world. An immense dimmer board operated by motors made by the Cutler-Hammer Manufacturing Company has just been installed to operate on a 220-110-volt three-wire system. This board, shown in Fig. 6, consists of six panels of black enameled slate, each about eight feet high by twenty-five feet wide. Standard dimmer plates are not used on this apparatus, but resistance grids and small inclosed-type resistance units are used, arranged to give the very finest and gradual variations in the brilliancy, and causing the lamps to glow and fade

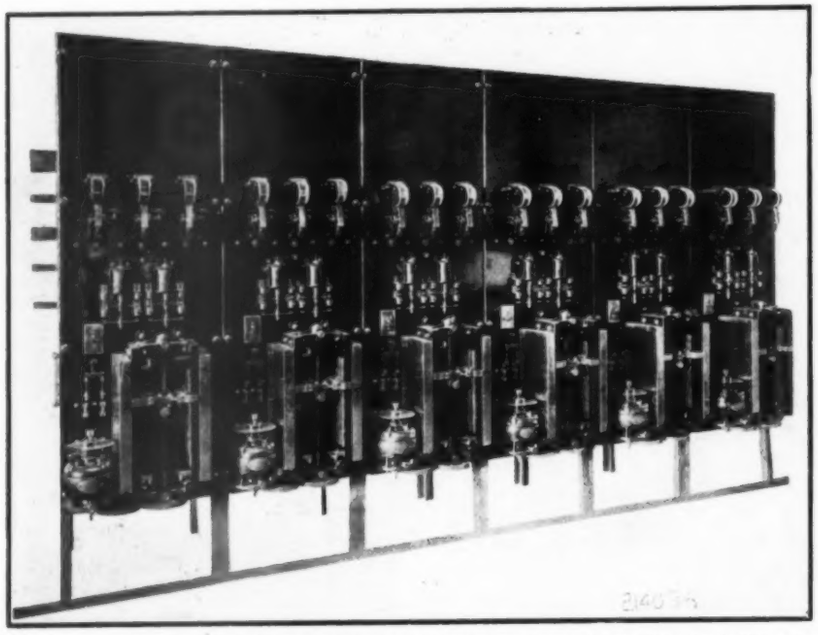


FIG. 6.—MOTOR-DRIVEN REMOTE-CONTROLLED DIMMER PANELS IN CATHEDRAL OF ST. JOHN THE DIVINE.

by imperceptible degrees. The devices on each of the six panels are a thirty-ampere 250-volt switch with fuses of the same rating, one flush push-button switch, three clapper-type solenoid-operated switches for the 220-110-volt three-wire mains, two reversing solenoids which carry only the motor-control current, and a Watson one-eighth horsepower 220-volt motor which drives a cross-head by means of a worm wheel cutting in and out the dimming resistance. The resistances are supported on the back of the boards and all wire used in the back of board connections has fire-proof covering.

Throughout the church push-button stations similar to the one on each panel and in parallel circuit with it, will be placed to control the motor and therefore the dimming remotely. This control is accomplished by the two reversing solenoids. When one solenoid is energized the motor runs in one direction, slowly varying the candlepower of the lamps in circuit, while when the other solenoid is energized the reverse occurs. The resistance is designed for continuous operation.

New York Section, Illuminating Engineering Society.

On the evening of March 9 the New York Section of the Illuminating Engineering Society held its regular monthly meeting. The meeting place was the large new department store of Gimbel Brothers, the electric lighting of which formed the topic of a paper by Clarence L. Law and Albert J. Marshall. The attendance at the meeting was unusually large, but comparatively few of the 200 or so people present were connected with the Society. An opportunity to inspect the lighting features of the building was afforded. The paper was presented and discussed in the auditorium on the eighth floor. A brief synopsis of the paper, the title of which was "The Lighting of a Large Store," is given below.

Gimbel Brothers' New York store is one of the largest department stores in the world. It has ten floors above street level and three basements below. The scheme of lighting was designed by an engineer connected with the architects of the building. It provided for electric lighting from ceiling outlets at about twelve-foot centers, the fixtures being of the single-pendant chain-stem type with tungsten lamps inclosed in spheres of yellowish-orange tint. Shortly before the building was completed and after considerable work had been done on the fixtures, Messrs. Law and Marshall were called upon to look over the proposed lighting design. This they criticized severely in many respects, particularly for the lack of efficient reflection and for the color of the spheres proposed. They made three sets of alternative suggestions: the first that the lamps be bowl-frosted and provided with prismatic intensive reflectors, also that one 250-watt be used in place of three 100-watt lamps at each of the main-floor outlets; second, that the pendants be provided with clear tungsten lamps and prismatic reflector balls having satin finish on the lower hemispheres; third, that each lamp be provided with a prismatic reflector and the whole inclosed in a lightly ground glass sphere. As a considerable part of the lighting equipment had been manufactured already it was not feasible to adopt any of these suggestions completely, but some were accepted in part, particularly the substitution of ground glass balls for the yellowish-tinted ones, and the use of single lamps therein. The gist of the report made by Messrs. Law and Marshall is given in their paper, which is accompanied by some sixty illustrations and many tables of data and test results. The electrical supply of the building is from the central-station system of the New York Edison Company, which installed a substation in one of the sub-basements to supply the total connected load of about 10,000 horsepower. On completion of the building an extensive series of photometric and illumination tests was ordered by the Edison Company to be undertaken under the supervision of the authors. These are summarized in the latter part of the paper.

Owing to the large number of guests present at the meeting and the paucity of illuminating engineers, the discussion of the paper and of the lighting scheme finally adopted did not cover the points involved very thoroughly. The main floor of the building appears to be over-lighted, which is probably due to the fact that not only is excessive light used, but that the ceilings, walls and pillars are of a clear white. Most of the discussion centered around this feature, those participating being Messrs. Millar, Codman, Ashe, Macbeth, Owens and Stickney.

Tungsten Lamps for Circus Lighting.

The auditorium of Hengler's Circus at Glasgow, Scotland, is now entirely illuminated by means of tungsten lamps. In this installation there are ten 1,000-watt, nine 400-watt, two 100-watt, twenty-five fifty-five-watt and 140 thirty-two-watt Osram lamps.

Thousand-Candlepower Tungsten Street Lamps.

In Torquay, England, a number of 1,000-candlepower tungsten lamps have been installed for street lighting and are said to give excellent results.

TELEPHONY—TELEGRAPHY, and WIRELESS.

TELEGRAPH REPEATERS.

BY H. P. CLAUSEN.

In studying the operation and circuit connections of telegraph repeaters, the circuit designer always finds it of great interest to thoroughly understand the operation of such repeaters as the Milliken, Ghegan, Weiny-Phillips, and other types which have, from time to time, made their appearance.

It is not the writer's intention to discuss the whys, wherefores and hows of telegraph repeaters in general, but, rather, to consider three types of repeaters with which he has made some experiments and found to operate quite successfully. The simplicity of the arrangements is among their chief advantages. Ordinary relays such as are used in telephone exchanges can be connected to operate quite successfully.

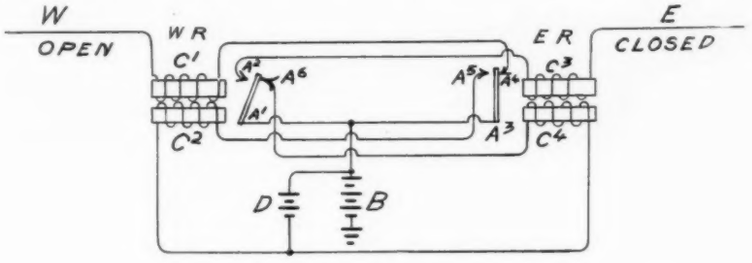


FIG. 1.

In the standard forms of telegraph repeaters we generally find quite an imposing array of coils, armatures and many ingeniously arranged combination movements which require a careful examination in order to appreciate the complexity of their arrangement and operation.

Referring to Fig. 1, this represents a type of telegraph repeater in which a main battery *B* is located at an intermediate point upon a circuit connecting to the *E* and *W* wires. The coils C^1, C^2, belonging to the *W* terminus of the line are so placed upon the relay structure that both windings independently control the armature A^1. Such a relay is shown by Fig. 2, where the two windings are shown in their proper relative positions towards the armature. The *E* wire is similarly equipped with the relay *ER*. A battery *D*, comprising a few cells, delivering, say, current at about six volts, is supplied for the purpose specified below.

Let us assume that that the circuit has been connected to the *E* and *W* terminals of the telegraph line and that the battery *B* consists of a suitable number of cells. With both the *E* and *W* terminal circuits closed, current passes from battery *B* over the line *E*, through the A^1 armature to the A^2 front contact, and from there through to the winding C^3. This results in energizing the *ER* relay winding and keeping armature A^3 drawn up into contact with point A^4. This results in causing battery current to flow out over the *W* line through the winding C^1. Now, let us say that in commencing to send a message from the *E* terminal the circuit is interrupted. This will cause the winding C^3 to be deenergized and result in interrupting the battery current flowing up to this moment over the *W* circuit and through winding C^1. This would tend to drop the armature of the C^1 winding were it not for the fact that when armature A^3 of relay *ER* drops back, current from battery *D* flows through A^5 contact upon which the A^3 armature rests and causes an energization of the C^2 winding of relay *WR*. This prevents the A^1 armature from dropping and interrupting the current supply necessary for maintaining the continuity of the *E*-wire circuit. Should operator *W* break while *E* is sending, the sounder at the *E* station immediately indicates the fact through armature A^1 dropping back upon contact A^6 and preventing the armature A^3 of relay *ER* from interrupting the *W* circuit, this naturally resulting in the circuit of the *E* operator standing open, and therefore calling for closing the key and hearing what the *W* operator may have to say.

In this repeater it is desirable that the shift from the front contacts of the armatures to the back be made practically without breaking the circuit, although this is not absolutely essential. It will be observed, however, that if we provide the armatures with a contact as shown by Fig. 2, which we will term a make-before-break contact, the shifting of the connections is made without any chance for improper operation.

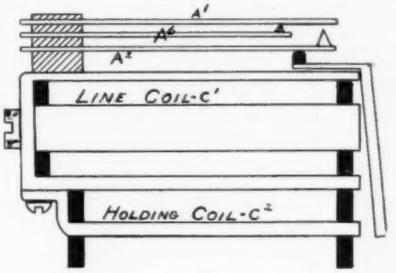


FIG. 2.

It is observed that with the arrangement shown by Fig. 1, should both ends of the line stand open, that is to say, open at practically the same instant, both A^1 and A^3 armatures would tend to drop back, but whichever armature first strikes its back (and normally open) contact, the line with which it is associated is not the line which will have its armature locked up. Say the *W*-line armature drops back first; this will cause current to flow through the C^4 winding and hold the armature A^3 up to its front contact. This then maintains battery upon the *W* circuit. *E*, however, is also open, and no current

passes through C^3 winding, and it will require a closure of the W circuit before any current may be obtained over the E circuit, the line standing practically open.

This arrangement of repeater works out something like the Weiny-Phillips and, it may be said, has the objection of calling for auxiliary windings upon the relay—that is, more than one winding upon a relay may be considered objectionable.

Referring now to Fig. 3, we have a slightly different arrangement. We again have the main-line battery B and the auxiliary battery D; also wires W and E, coils C^1 and C^3. With both terminals of the circuit closed, it is observed that first battery upon the contact A^2 passes to the armature A^1 through the winding of C^1 and out over the W line. Since C^1 winding is energized, armature A^3 is drawn up, makes contact with point A^4. This permits battery B^2 to project current through the relay winding C^3 and over the apparatus which may be connected to the terminus of wire E.

Now, let us open wire E. The relay C^3 becomes deenergized. Armature A^1 drops back and places current from auxiliary battery D^1 upon the winding C^1, over the back contact A^5. This prevents the deenergization of relay C^1, and therefore maintains the continuity of the E circuit through C^3 winding to battery B^1. The W-line circuit, however, stands completely insulated at the repeater station and therefore any apparatus connected to the W terminal of the line will be without current. Obviously, the reverse action takes place when the W circuit is opened. In this case, the C^3 winding receives current from the D^2 auxiliary battery owing to the armature A^2 dropping back. With both line wires open, the tendency, of course, is for both armatures to drop back, whichever armature, however, falls back first, it results in locking up the relay of the opposite line terminal.

This arrangement of repeater equipment as shown by Fig. 3 is quite simple, but has, perhaps, the objection that we are required to supply two auxiliary batteries, D^1 and D^2, but, so far as the relay equipment is concerned, the arrangement is quite practical and operates successfully, as explained.

Now, referring to Fig. 4, we have a plan which eliminates the auxiliary batteries, although the main battery has been supplied in duplicate. As a matter of fact, this duplication of the main battery quite frequently becomes necessary in any form of repeater, as the E circuit may require a higher potential to operate it successfully than the W circuit. With both line circuits closed, current will flow through coils C^1 and C^2, resulting in their armatures, A^1 and A^2, being drawn up, making contact with the W and E wires, as shown. Current over the E line is had from battery B^1, while battery B^2 supplies current to the west line, each battery being of suitable potential for supplying sufficient current to operate the circuit.

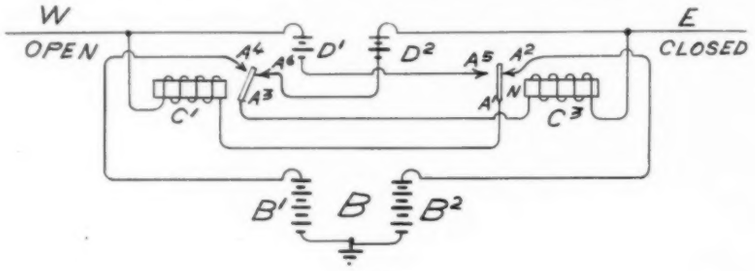


FIG. 3.

When the E operator begins to send, opening his circuit results in the deenergization of the C^1 winding, which is the winding associated with the relay forming a part of the W circuit. When the W-circuit relay drops back its armature, the current from battery B^2 ceases to flow over the W line, but, in order to prevent any chance dropping-off of the relay associated with the E circuit, that is, the ER relay, armature A^1 of relay WR drops back on contact A^3 and reaches the earth side of the battery B^2 through the winding C^2. Therefore, the A^2 armature does not break its connection with the A^4 terminal of the line E, which, in effect, means that the E operator can continue to send, causing the armature A^1 to draw up and fall back, controlling the current supply to the line W, without any interruptions; but should the W operator interrupt the very first closure of the E circuit, causing the armature A^1 to make contact with A^5, current ceases to flow through the winding C^2 and therefore results in the armature of this relay dropping off and interrupting the current supply to the E-operator's set. Should both lines open, it is evident that one of the armatures dropping back first will cause the winding of the opposite circuit relay to be energized and thus prevent any chance of the repeater-station equipment going dead and being made unreachable, even though both the W and E terminals of the circuit are closed.

In systems where the battery B is located at the main offices, operating upon the plan known as "central energy," it is possible to use either the plan shown by Fig. 1 or that shown by Fig. 3, by simply connecting the wires which extend to the batteries directly to earth. It is not possible for the line to go dead,

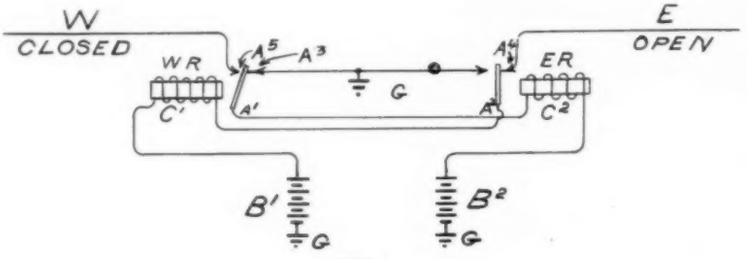


FIG. 4.

due to the batteries D holding up one or the other of the two relays.

The plan illustrated by Fig. 4, however, is not suitable for central-energy service unless we cut a battery between the wire A^3 A^5 and the ground G, this battery to be of sufficient potential for holding up the relay armature A.

A petition in bankruptcy was filed a short time ago against the Radio Telephone Company by three creditors whose claims aggregated a little less than $1,000. The liabilities are stated to be $25,000 and the assets only $5,000, although the authorized capital was $2,000,000.

Operative Wireless Direction-Finders.

To the Editor:

Replying to your inquiry, the history of the operative wireless direction-finders, so far as I am aware, is briefly as follows.

The first direction-finder was invented by Herman W. Ladd. He employed me to reduce his invention to practice, but I found that, in order for it to work with any considerable degree of precision, the waves should be not much over four inches in length, owing to the greater diffraction of longer waves. As such short waves were wholly impracticable owing to the impossibility of radiating any considerable amount of energy at such short wavelength, the experiments with the Ladd direction-finder were finally abandoned.

The next direction-finder was one invented by me. It was repeatedly tested with good results on board government vessels. It gave the line of motion of the waves to within one-half to two-thirds of a point over distances ranging from twenty to seventy-five miles approximately. It had the defect that it required for its operation "swinging ship," or at least a certain amount of manœuvering of the vessel.

The next direction-finder to be brought out was one whose invention was claimed by both Marconi and a young British naval officer, whose name for the present moment I do not recall. This direction-finder gives the line of motion of the waves, but with less precision than it is given by my previously mentioned direction-finder. It moreover has the same defect of requiring the manœuvering of the vessel or "swinging ship" in its operation.

The next direction-finder brought out was one claimed by two Italians, Messrs. Bellini and Tosi. Their direction-finder does away with the necessity of manœuvering the ship, but its range is relatively limited, and, as in the case of the previously-invented operative direction-finders, the Bellini and Tosi direction-finder gives only the line of motion of the waves and does not give the direction of motion of the waves along their line of motion.

Recently I have been granted a patent for a direction-finder which, like the Bellini and Tosi device, does away with the necessity of manœuvering the vessel. The invention of this patent still has a defect in that it does not give the direction of motion of the waves along their line of motion, but like previous operative direction-finders determines the line of motion alone.

Finally I have still more recently invented a direction-finder by which the direction of motion of the waves as well as their line of motion is determined. This direction-finder does not require that the helm of the vessel shall be touched. The determination of the direction of motion of the waves is effected by turning a single handle and the direction of motion of the waves as well as their line of motion is indicated by a pointer on a dial or compass card. The present invention has much detail, the best design of which will need to be carefully worked out with the assistance of practical experiments.

JOHN STONE STONE.

Boston, Mass., March 6.

Telephone Growth in Canada.

Canada is estimated to have 240,000 telephones or 3.4 per cent of the world's total. Last year there were over 400 companies operating in Ontario, with over 50,000 subscribers and a combined capital of not less than $2,500,000.

The Bell Telephone Company of Canada now operates in Ontario and Quebec only, having sold its plants in Manitoba, Alberta and Saskatchewan to those provinces for government operation. The company exchanges business with more than 300 independent companies. The increase of its business in recent years is shown in Table I.

TABLE I. BELL TELEPHONE COMPANY OF CANADA.

Year.	Subscribers.	Miles Wire.
1904	66,160	32,211
1905	78,195	37,082
1906	95,145	43,400
1907	111,118	49,748
1908	103,084	46,879
1909	114,735	48,969

The province of Manitoba paid $3,400,000 in January, 1908, to the Bell Company for its plant and franchise. According to the report of the Telephone Commission there are 29,748 telephones on the system, of which 11,181 are busines, 11,537 residential and 7,030 rural. The connecting systems have 2,799 rural subscribers and 899 exchanges, giving a total number of subscribers served by the province of 33,446. These figures show an increase during 1910 of 8,338 subscribers or thirty-nine per cent. The increase in Winnipeg amounted to 3,472 subscribers or twenty-seven per cent. The long-distance lines have an aggregate of 5,631 miles of which 1,481 miles were built in 1910. The revenue from long-distance business rose from $203,000 in 1909 to $243,371 in 1910, an increase of nineteen per cent. The system now comprises 111 exchanges and 239 toll stations. Revenue during 1910 rose to $1,038,466 against $792,632 in 1909. Of this long-distance tolls amounted to $243,371. In Winnipeg there are now four exchanges with a fifth in course of construction. During 1910 two small systems were absorbed by the province —the Melita-Arthur and Morton municipal systems. The long-distance line eastward to connect at the boundary with the Warroad Telephone Company, of Warroad, Minn., will be completed early this year. This will give connection to Fort Francis, Ontario, and a long-distance line is contemplated from Fort Francis to Duluth, Minn., which will give Winnipeg a short line to the Zenith City. A high-class copper-wire line was built south to the international boundary where it connects with the lines of the Northwestern Telephone Exchange Company, thus forming a direct through circuit to Chicago. A force of 550 men was maintained during the past summer in building rural lines in the province. There are 453 operators in the Winnipeg exchanges with 210 more scattered over the province in the smaller exchanges. $339,960 was expended by the operating department in 1910 and $264,781 on maintenance. General expenses, which include salaries and expenses of administration, insurance premiums and interest amounted to $79,029. This makes a total of $683,770, less an amount collected from subscribers for moving, etc., of $50,075, making the net cost for the year $633,695.

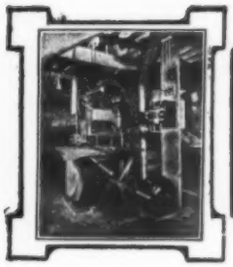
The capital account for the past year is shown in Table II.

TABLE II. TELEPHONE INVESTMENT IN MANITOBA.

Plant construction	$ 612,025.39
Exchange equipment	309,070.94
Purchase of Melita-Arthur Tel. Co.	20,000.00
Plant in process of construction	746,922.94
Real-estate purchases in Winnipeg	91,717.80
General expenses, salaries, etc.	65,469.57
Supplies	564,752.54
Tools and teams	41,392.70
Miscellaneous	21,230.33
	$2,490,148.92

The report shows that the total capital invested in the telephone system to date is $7,600,000.

Extensive construction is contemplated for the present year, especially on long-distance lines.



Industrial Power

ELECTRICALLY OPERATED MILLS

BY C. H. PALMER.

It is not intended in this article to raise the question of the electric versus the mechanical drive, either as regards the efficiency of transmission or the effect of electric driving on the production of a mill. It is merely intended to describe the methods of applying electric drive which have been generally adopted in Great Britain and which having now stood a reasonable time test may be considered successful and furnishing a sound basis for further development and enterprise.

Systems of generation and distribution of electric current do not come within the scope of this article. The choice of a system of gearing is affected by quite a number of factors; the chief being such as the nature of the electricity supply, the character of the work to be done and the type of the mill building. Wherever an external supply of alternating current is used it is usually necessary to employ induction motors.

The synchronous motor, not being self starting, is undesirable, and is also, in the case of cotton-spinning mills, of no use for driving self-acting mills, as it is liable to be thrown out of synchronism and to be stopped by the overload due to the reversal of the action. Attempts have been made to use the single-phase commutator motor, in many cases with success. In Italy it has been successfully applied to cotton-mill machinery, in Great Britain for other purposes. The advantage of the single-phase series motor is that its speed can be varied to suit either the quality of the material being worked up, or to adjust it to give the best possible speeds at different stages of manufacture. On the other hand, the series motor is liable to fluctuate in speed under varying loads and thus tend to affect the production. The use of a two-phase motor, one phase supplying the field and another the armature, has not so far been tried, but it should have considerable advantages, as it would have the general characteristics of a direct-current shunt motor and could easily be regulated as to speed.

The various alternating-current commutator motors work best with low-frequency currents. Twenty-five or thirty cycles is about the limit and fifteen is often recommended by experts in Great Britain; but the vast majority of alternating-current supplies in England are between 50 and 60 cycles, and only a very few are at lower frequencies than 40, so that unless a mill has its own power supply the alternating-current commutator motor may be considered as out of the question in most cases. It is true that frequency changers can be used (consisting of a motor-generator set) but the cost would be very considerable, the loss of efficiency appreciable and the gain practically nothing, if not indeed negative with the commutator motor in its present state of development.

In the main the induction motor gives satisfactory service. It can be started like a direct-current motor and will give a steady speed regulation. It is, however, essentially a constant-speed machine and cannot greatly vary its speed to suit the work required. In most cases this is not a drawback, as it is only occasionally that a change in speed is wanted in many works. In a great many cases machinery runs at one speed all the year round and from year to year. The demand for a variable-speed motor for such work is indeed quite new and very limited in extent. Where the available supply of electricity is of the continuous-current kind results quite equal to those given when alternating current is used can be obtained. Also any speed variation that may be desired can be arranged for without difficulty. In many mills, especially cotton, wool or flax, the danger from fire is perhaps slightly increased by the sparking of the commutator, but this can be guarded against. In flour and oil mills in which electric drive is or may be introduced, the point scarcely arises. Both the alternating and continuous-current systems are in use at present, although the former, arranged on the constant-speed plan, is the more common in Great Britain.

A great deal of discussion has occurred from time to time as to the relative merit of the group and individual motor drive for works and mills containing a very large number of machines, such as flour mills, cotton spinning mills, oil mills, and the innumerable other varieties in the large English and Scotch manufacturing districts.

So far the system of group driving has held almost undisputed sway and will in all probability continue to do so. The individual drive makes each machine an independent unit and also avoids the use of long line shafts. Both of these features are of comparatively small moment in many works for the bulk of the machines; it seldom happens that the machines are run independently. When temporarily stopped the belt is run on the loose pulley, which is as convenient as stopping the motor. Further, with the motor-drive it is frequently necessary to use a countershaft, which is a greater nuisance than the equivalent portion of the line shaft which it displaces. Many machines require only a moderate power to drive them—say one five or ten-horsepower motor—in any case the motors generally required for individual driving are very small and therefore very costly and, moreover, occasionally somewhat inefficient; and because of their small size, their speeds are high and necessitate gearing down to suit the machine speeds.

Except, therefore, in the case of isolated machines, the individual drive in a great many works possesses only small advantages and it has for many purposes, at least in Great Britain, the considerable disadvantages of low ef-

ficiency and high first cost and maintenance. The group drive on the other hand is relatively cheap to install and to maintain. Further its efficiency is higher and its speed regulation better than that of a number of small motors driving separate machines. It can, moreover, be applied to existing works with the minimum of alteration and expense. The mill gearing is arranged very similarly to uses in steam-driven mills, except that the main rope race gearing (should there be one) is abolished and motors of considerable size are placed so as to drive the various lines of shafting. The electric motor being naturally a high-speed machine, it has been necessary in many cases to drive from the motors on to the shafting by ropes; in other cases the shafting has been considerably speeded up and the motor coupled up directly. When this is done the motor has to be of the slow-speed type and is relatively large.

In the case of very long lines of shafting two motors per line are frequently employed, one driving from each end and the shafting being in two separate lengths. In this way the weight of the shafting is somewhat reduced, apart from the increased speed at which the lines generally run as compared with the mechanical drive. This high speed, of course, admits of the use of lighter and less costly shafting, although it does not reduce the friction losses, which are at least as great because of the higher bearing speeds and the greater number of bearings which are often necessary. In many cases where bevel gears have been used, they are generally avoided when motor-driving is installed. In some works a separate motor is applied to each line of shafting and usually has to be geared down either by ropes or wheels, as the natural speed of many machine shafts is relatively low. In some cases one motor drives two or three lines of shafting, thus enabling a larger, cheaper and more efficient motor to be used. Perhaps the greater advantage of the electric drive is its adaptability to conditions where a mechanical drive would be awkward.

A plan is in contemplation at Guayaquil, Ecuador, to develop a water power in the foothills of the Andes, about fifty miles from the city, and transmit it electrically to the port.

Electric Power for Indian Mills.

Recently Sir George Clarke laid the foundation stone of the works at Lonavala Tatas of the Hydroelectric Power & Supply Company. The scheme, which is interesting as the greatest yet attempted in India, consists of damming the valleys in the Ghauts for the storage of water power convertible into electric power.

The dams will be 8,900 feet in length and from thirty-two to seventy feet in height, creating lakes 2,521 acres in extent, with a capacity of 3,000,000,000 cubic feet, with a fall of 1,730 feet. The estimated output, 40,000 horsepower, will be transmitted to Bombay, forty-three miles away. The cotton mills will be the chief consumer. Not the least interesting feature is that the capital is exclusively Indian. It will be completed probably in 1913.

The governor in his speech commented on the theory that India was being ruined and that her industries were perishing. So far from Manchester having killed the cotton industry in India, the mills had increased in the past decade by twenty-two per cent and the spindles by twenty-six per cent. The company, added his excellency, was formed in great measure by those ruling princes who had shown in a practical fashion their trust in the future of the country.

New Swiss Electric Locomotive.

A large electric locomotive has been built recently for the Spiez-Lotschberg-Simplon line of the Berner Alpenbahn Gesellschaft. It is intended to draw heavy trains with a range of speed varying from zero up to 43.5 miles per hour, and capable further of working on direct current, single or three-phase alternating, with merely minor alterations. The locomotive weighs eighty-eight tons, all of which is available for adhesion. This weight is carried on two six-wheeled trucks, all the wheels on each truck being coupled together by side rods, while the power is transmitted from the first gear reduction to the driving rods by an outside connecting rod like a steam locomotive. The great power of the locomotive is apparent from the fact that it can exert 2,000 horsepower continuously and 3,000 horsepower for short periods, and, considering that it weighs only eighty-eight tons complete, it may be considered the lightest locomotive of its power in the world.

Trackless Trolley Installation.

According to the London *Times*, two installations of trackless trolleys have lately been constructed to connect the outlying districts of Bremen with the ordinary tramway service. The cars are about the size of motor omnibuses, but of lighter construction. The cost of construction is stated to be about one-fourth that of ordinary tramways. Electric conductors, one for the positive and one for the negative, are placed about eight inches apart, one above the other, the trolley consisting of two rollers, which travel on the upper wire, and two hoops which are pressed against the lower one. In order to allow the car to deviate from a straight line and to pass other vehicles, the wires connecting the car with the trolley are automatically uncoiled from a drum placed inside the car. This drum also takes up the spare wire immediately it becomes slack. For small deviations, up to six feet, a patent cable loop is provided. On one car meeting another, the conductors of the cars exchange trolleys.

A Departure in Electrification.

A Fort Wayne, Ind., manufacturer of steel tanks, whose plant is half a mile from the railroad, secured a franchise for a siding, which was granted on condition that no steam locomotives be used. The difficulty was met by pressing into service a heavy duty electric truck equipped with a standard M. C. B. coupler. This somewhat unusual motive power is said to have a capacity for hauling three loaded or five empty cars, and it also performs the work more to the convenience of the manufacturer and more cheaply than could be done by means of locomotives. The extension of the tracks into the shops allows direct loading and unloading from cars, and permits a saving on horses displaced and men released, of $30 per day.

Gasoline-Electric Car For Railroad.

The Great Western Railway Company of England has ordered a gasoline-electric car to meet the requirements of branch-line working. It will accommodate forty-five passengers and weighs sixteen tons loaded. Driving will be possible from either end.

Exports of copper for the week ended March 9, were 5,537 tons.

Hints on the Care and Operation of Motors and Generators.

The care and operation of dynamos and motors are important duties of the engineer or electrician under whose supervision the successful operation of those machines is looked for, and nowadays the engineer is oftentimes his own electrician. When the voltage fluctuates it is a sign that either the plant is overloaded or something has happened. Assuming that the plant is working under normal conditions and the voltage is not constant, one of the following difficulties may be looked for: First, loose brushes in the brush-holders or light brush contact against the commutator; loose joints or connections; weak springs that are not sufficiently strong to feed the brush against the commutator bars; uneven commutator surface or the surface covered with a film of oily matter. All of these will tend to lower the voltage. When the voltage drops without any apparent cause, such as load or speed, or other apparent reason, then the brushes and commutator should be sand-papered, for then a thin film of non-conducting material will be found between the brushes and commutator, which lowers the voltage. While it is desirable to have the commutator covered with a brown glaze, still this surface must be removed occasionally providing we are to hold the voltage at the desired point.

There is always a rise in the voltage when the commutator and brushes are properly sandpapered. At present dynamos are so wound that there is hardly any sparking from no load to full load, but at times sparking will occur with the best-constructed machines, and when it cannot be removed by trying the known remedies, then there is every likelihood of commutator trouble. Should it appear, it will be noticed by reason of two or more burned bars at some point in the commutator surface. In such a case the sandpapering of the commutator will only increase the difficulty. The correct remedy is to have the burned bars reinsulated and the corresponding coils wound, because in nearly every case of burned bars the coils will be found bad. Heavy sparking at a particular brush is an indication of an open circuit in the armature coils, and this is denoted by a rapid wearing of those commutator bars which belong to the open coil. The only correct remedy is the one previously mentioned. When it becomes impossible to do this there is a way to stop the sparking. This can be done by soldering a piece of wire or flat copper bar across the burned or injured bars, thus closing the coil with the next good coil. This at best is only a makeshift, although it may be found expedient at times to do so to keep the plant running until proper repairs can be made.

Motor repairs are almost identical with dynamo repairs. There are, however, some things met with in the operation of motors that seldom present themselves in dynamos. In general dynamos are direct driven, and the strain and wear on the bearings are evenly divided. With motors this is reversed, because the motor must pull on the pulley side, and consequently the belt strain throws the armature out of alinement and gradually destroys the clearances. This is the result of the wearing of the motor bearings. In testing for clearance it will be noticed that the clearance is least in the direction of belt strain or pull. If we allow this wear to continue the result will be an injured armature, because the armature will strike or rub against the horns of the pole pieces and either wear off the binding bands or cut one or more of the armature coils. It is important, therefore, to watch the wear of the bearings and not allow it to permit the armature to strike or rub against the poles. In testing for clearance always use a strip of metal of sufficient thickness to pass between the armature and pole pieces, and when this strip cannot pass it indicates wear. Since we then know the armature is approaching the poles we may make preparations for the renewal of bearings at a time when the motor is not needed. Another way to test for clearance is to have a lamp placed at one end of the armature and then sight through between it and the pole pieces. In this way we may quickly determine the amount of clearance.—*Engineer and Iron Trades Advertiser.*

Electric Smelting in Canada.

An electric smelting plant is to be erected at Cleat Falls, about twenty miles west of Ottawa, on the Ottawa River. The district possesses rich deposits of iron ore, and plenty of water power is available.

Electricity For Industrial Establishments.

The Lehigh Coal & Navigation Company purposes to engage in the supply of electric light and power on an extensive scale in some of the interior counties and has made application at Harrisburg for twenty-five charters for electric companies, in all of which officers of the Lehigh Coal & Navigation Company are named as incorporators.

It is proposed to erect a large power plant in the vicinity of the company's mines at Hauto, in the Nesquehoning Valley, above Mauch Chunk, and to distribute electricity in Carbon, Lehigh and Northampton counties. It is intended ultimately to supply 100,000 kilowatts and to install at first equipment to supply 20,000 kilowatts, which equipment will be increased from time to time as the demand for power may justify. The territory which will be reached by the company is one in which power is used on a very large scale, not only in the manufacture of cement, but in iron and silk mills and other important industrial establishments.

An Electric Telescope.

Professor Rosing, of the Technological Institute of St. Petersburg, is credited with the invention of an electrical apparatus by means of which an observer sees a picture of whatever scene is exposed to his distant apparatus. By its use an observer at home or in his office may see what is going on in the street, in the theater, in the railroad station, on the battlefield, etc. The details of construction have not been disclosed.

Boston Elevated Orders More Cars.

In addition to the twenty cars ordered from the Pressed Steel Car Company for its elevated lines, the Boston Elevated Railway has placed an order with the Standard Steel Car Company for forty steel passenger cars to be used in the Cambridge subway.

Compulsory Block Signals.

The bill requiring the adoption by all steam and interurban roads in Indiana of an automatic block signal system, with a provision that the railroad commissioners may permit, at their discretion, some other system to be used, was passed by the senate of the Indiana legislature on March 3.

INSULATION OF 2,300-VOLT LINES.—I have seen the statement several times that linemen should not depend on the insulation of live 2,300-volt lines, but should treat them as if they were bare, What is the use of insulating such wires then? Why is the insulation no good? —F. A. L., Helena, Mont.

The reason why linemen are cautioned about 2,300-volt lines is that a number of fatalities have occurred from contact with such lines where the insulation was subsequently found to have deteriorated so much as to be worse than useless. This does not mean that the insulation is never of any account or accomplishes no good. It has been found that the ordinary weatherproof insulation was in fairly good condition after nearly twenty years' use in places not particularly exposed to adverse conditions. In other places, however, the deterioration is very rapid, for instance where the line passes through trees and is subject to considerable rubbing against the branches or where it crosses or runs along a steam railroad and is exposed to moist sulphurous gases and bombardment by hot cinders. Where the weather conditions are unusually severe, such as frequent and great changes of temperature, accompanied by alternate wet and dry spells, the insulation will crack and become unreliable in short time. In order to be on the safe side, therefore, a lineman cannot be too careful of apparently insulated lines carrying over 600 volts. It is true that well constructed bare lines would be equally safe and serviceable, but would not meet the ordinary municipal requirements. The poles would have to be provided with sharp prongs or barbed-wire guards to keep the irresponsible small boy from climbing them.

ARCS AND TUNGSTENS ON STREET-LIGHTING CIRCUITS.—Is it practical to put tungsten lamps on the same series circuit as 6.6-ampere alternating-current arcs?—M. T., Moline, Ill.

It is now very common to put series tungsten incandescents on the same circuit as series arcs. For this reason series tungsten lamps are made in such current capacities as are commonly used for series arc lamps. If they have the same current rating, tungsten lamps can also be used as well with direct-current as with alternating-current arcs.

INVERTED THIRD RAIL.—Have any electric railways using a live third rail taken any measures to working or protecting the live rail?—R. M., Aurora, Ill.

This has been done in a number of installations. Planks have been placed alongside the third rail and attempts have also been made to partly cover it. These have given some trouble from snow. Undoubtedly the most successful third rail protection is obtaind by inverting this rail so that its contact side is underneath and the rail is thoroughly protected on the top and one side; the contact shoes bear upward against the lower side of the rail. The best example of this construction is on the New York terminals of the New York Central and Pennsylvania lines.

CONDUIT SIZES FOR TWO AND THREE-WIRE RUNS.—Kindly publish data giving the size of conduits required to take stranded wire from No. 8 B. & S. gauge to 400,000 circular mil cable. Please give these sizes for two wires in the pipe and also for three wires in the pipe.—J. R. P., Ogden, Utah.

The amount of clearance to be provided in iron-pipe conduit depends principally on the number and nature of the bends, thickness of insulation and stiffness of wire. The following table is based on filling about two-thirds the area of the conduit. Both in the two-wire and three-wire conduits the wires are assumed to be of the same diameter. The table gives conduit sizes for both single and double-braid covering:

CONDUIT SIZES FOR STRANDED WIRE.

Size of Wire.	—Single Braid— 2 wires. (inches.)	3 wires. (inches.)	—Double Braid.— 2 wires. (inches.)	3 wires. (inches.)
8 B. & S.	¾	¾	¾	1
6 B. & S.	¾	1	1	1¼
4 B. & S.	1	1¼	1	1¼
3 B. & S.	1	1¼	1¼	1½
2 B. & S.	1¼	1¼	1¼	1½
1 B. & S.	1¼	1½	1½	2
0 B. & S.	1½	2	1½	2
00 B. & S.	1½	2	2	2
000 B. & S.	2	2	2	2½
0000 B. & S.	2	2½	2	2½
300,000 C. M.	2	2½	2½	2½
400,000 C. M.	2½	2½	2½	3

DISTURBING INFLUENCE OF NEIGHBORING CIRCUITS.—Recently I saw a pole line carrying a three-phase power-transmission circuit on the upper cross-arm and, for about a mile along the road, also one side of an alternating-current series arc-light circuit on a lower cross-arm. The arc lamps hum a great deal when lighted. Is this not due to some inductive disturbance from the high-tension line? The power line is 13,200 volts, twenty-five cycles, I understand; the arc circuit is about 3,000 volts, six and six-tenths amperes and sixty cycles.—H. F. J., Topeka, Kans.

The humming of the arc lamps is due to some feature inherent in their construction and not to any serious inductive effect of the high power line. The induction from any one of the wires of this line is neutralized by that from the other two wires, since in any three-phase system the current at any instant in one direction on one wire returns by the other two wires. The inductive effect of the power line is therefore practically inappreciable on the lamp circuit, even if the power circuit is unbalanced, unless the arc circuit runs very much closer to one of the three power wires than it does to the others. Even so sensitive a circuit as a telephone line may be run beneath a power line, provided the former is a transposed metallic circuit.

MEMBERSHIP IN THE ILLUMINATING ENGINEERING SOCIETY.—What are the requisites for membership in the Illuminating Engineering Society? What are the dues and fees.—G. K., Milwaukee.

Anyone over twenty-one years of age, who is interested in the advancement of the theory and practice of illuminating engineering or in the improvement of the science and art of illumination, is eligible for membership in the Society. The annual dues are $5; the initiation fee has been waived until July 1, 1911, after which date it will be $2.50. Application should be made on a form that can be obtained from the general secretary, Preston S. Millar, 29 West Thirty-ninth Street, New York, N. Y., or from the nearest local secretary, F. H. Bernhard, 507 Marquette Building, Chicago.

FINANCIAL REPORTS OF ELECTRICAL COMPANIES.

KINGS COUNTY ELECTRIC LIGHT & POWER COMPANY.

The annual report of the Kings County Electric Light & Power Company shows that this company, in combination with the Edison Electric Illuminating Company, of Brooklyn, showed the total number of customers to be 23,866; an increase of 4,028 over the preceding year. The total connections in fifty-watt equivalents amounted to 2,036,473, or more than 264,000 in excess of the figure for 1909.

The replacement and reserve fund has been increased by $163,417.39, representing the difference between the depreciation credits made during the year and the cost of property withdrawn from service. The net credit in this fund amounted at the end of the year to $599,227.60. Several other accounts and funds have changed by a considerable degree.

The accompanying table gives a full account of the earnings of the combined companies:

	1910	1909
Gross earnings	$4,338,987.55	$3,733,840.41
Operating expenses, including general, technical, production and distribution expenses (except taxes)	1,734,923.54	1,551,728.32
Taxes	298,909.79	272,256.63
	2,033,833.33	1,823,984.95
Net over operating expenses	2,305,154.22	1,909,855.46
Bond discount written off	20,268.81	20,268.81
	2,284,885.41	1,889,586.65
Depreciation charges	539,346.48	430,260.74
	1,745,538.93	1,459,325.91
Fixed charges—bond interest, including interest on unfunded debt.	736,305.86	617,754.29
	1,009,233.07	$41,571.62
Dividends paid	800,000.00	800,000.00
	209,233.07	41,571.62
Payment to Brooklyn Edison Investment Fund in accordance with Employes' Profit-Sharing Plan	38,171.03	.....
Net Profit and Loss surplus	171,062.04	41,571.62
Previous profit and loss balance	$1,245,195.36	
Less adjustment of accounts previous years	74.66	1,245,120.70	1,203,623.74
Total profit and loss balance		$1,416,182.74	$1,245,195.36

The profit-sharing plan mentioned in the table was established in December and involved, for the year 1910, an expenditure of $38,171.03 to 614 employees. Connected with this is the pension plan, which provides for the pensioning of employees at the discretion of the Provident Committee, which consists of the general manager, general superintendent and treasurer, ex-officio, and two directors designated by the president. The rate of pension is not less than one per cent or more than two per cent per year of service of the average pay for the five years next preceding retirement, with a maximum of fifty per cent. Employees reaching the age of sixty-five years, after at least ten years of continuous service, are given the right to retire upon pension. The directors have voted to set aside the sum of $25,000 annually to provide for pension payments, the difference between such amount and payments actually made to accumulate as a pension fund.

HAVANA ELECTRIC RAILWAY.

The Havana Electric Railway Company report for the year ended December 31, 1910, compares as follows:

	1910.	1909.
Gross	$2,656,980	$2,488,617
Expenses	1,365,641	1,251,049
Net	1,291,339	1,237,598
Charges and taxes	448,129	443,984
Surplus	*843,210	793,614

*After allowing for 6 per cent on $5,000,000 preferred stock the balance, $543,210, is equal to 7.3 per cent on $7,463,703 common stock.

UTICA & MOHAWK VALLEY.

The report of the Utica & Mohawk Valley Railway Company for the quarter ended December 31, 1910, compares as follows:

	1910.	1909.
Total operating revenue	$ 315,266	$ 295,517
Total operating expenses	172,268	173,528
Net operating revenue	142,999	121,989
Taxes accrued	16,657	17,817
Operating income	126,342	104,172
Surplus after charges	70,163	48,266

MINNEAPOLIS GENERAL ELECTRIC.

The report of the Minneapolis General Electric Company for the year ended December 31, 1910, compares as follows:

	1910.	1909.
Gross	$1,276,141	$1,108,756
Expenses, taxes and interest.	873,269	830,961
Net income	402,872	277,795
Preferred dividends	60,000	60,000
Surplus	*342,872	217,795

*Equal to 10.16 per cent on $3,375,000 common stock, which includes new issue of $875,000 for which subscriptions close March 15.

DETROIT EDISON COMPANY.

The annual report of the Detroit Edison shows the following profit and loss account:

Profit and loss surplus Dec. 31, 1909	$390,613
Surplus for year after deducting divs.	458,382
Total	$848,995
Appropriated for depreciation	310,000
Adjustment (debit)	32,258
Profit and loss surplus December 31, 1910	$506,738

In his statement to stockholders, C. W. Wetmore, president of the Detroit Edison Company, says in part: "The number of customers increased 28.6 per cent during the year, and the total connected general light and power load was 92,429 kilowatts, an increase of 28.4 per cent for the year.

INDIANA UNION TRACTION.

The report of the Indiana Union Traction Company for the year ended December 31, 1910, compares as follows:

	1910.	1909
Gross	$2,364,628	$2,103,019
Operating expenses	1,239,314	1,113,429
Net	1,125,314	989,590
Fixed charges	1,023,574	948,756
Surplus	101,740	40,834

PIONEER TELEPHONE & TELEGRAPH COMPANY.

The Pioneer Telephone & Telegraph Company report for the year ended December 31, 1910, compares as follows:

	1910.	1909.
Gross	$1,844,654	$1,534,180
Expense	1,385,515	1,147,053
Net	459,139	387,127
Interest	38,617	112,721
Surplus	*420,522	274,405
Dividends	367,924	250,392
Surplus	52,598	24,013

*Equal to 9.1 per cent on $4,624,500 capital stock as compared with 6.1 per cent earned on same stock previous year.

HUDSON & MANHATTAN COMPANY.

The Hudson & Manhattan Railroad Company reports for the month of January compared as follows:

	1911.	1910.
Gross revenue, all sources	$ 386,397	$ 324,670
Expenses and taxes	186,933	142,799
Gross income	199,463	181,870
Interest, bonds outstanding.	243,958	228,850
Less interest chargeable to construction	54,375	57,911
Balance	189,583	170,938
Other charges	22,814	13,217
*Total deductions	212,398	184,155
Net income (deficit)	12,934	2,285

*Being fixed charges applicable against that portion of the property employed in present operations.

From July 1 to January 31 gross revenue amounted to $2,422,764, gross income after expenses and taxes $1,310,679, and deficit after charges $53,177.

In reference to the January income account of the Hudson & Manhattan Company, the company says:

"Increase of $4,241 in operating expenses for January was principally due to increased expenditures in repairing damage caused by fire in the company's main power house on December 19. There were also increased charges to passenger cars due to alterations to air brake equipment which will accomplish more efficient and economical operation in the future.

"It will be noted that the interest charges against income have been increased $18,645, by reason of putting into operation additional property."

This is in reference to the Thirty-

third Street and Sixth Avenue extension, which was opened for operation during the latter part of 1910.

INTERBOROUGH RAPID TRANSIT.

The earnings of the Interborough Rapid Transit Company for the month of January and seven months ended January 31, 1911, compare as follows:

	1911.	1910.
Gross operating revenue..	$ 2,659,952	$ 2,587,487
Operating expenses	1,091,360	969,769
Net operating revenue..	1,568,593	1,617,719
Taxes	157,053	151,885
Income from operation..	1,411,541	1,465,836
Other income	25,248	30,956
Total income	1,436,789	1,496,791
Interest, rents, etc., including Manhattan guarantee	888,463	886,142
Net corporate income...	548,326	610,649
Passengers carried	51,676,010	50,222,606
July 1 to Jan. 31:		
Gross operating revenue..	16,946,641	16,512,297
Operating expenses	7,017,922	6,349,577
Net operating revenue..	9,928,719	10,162,720
Taxes	1,080,528	985,662
Income from operation..	8,848,191	9,177,057
Other income	199,694	258,953
Total income	9,047,885	9,436,010
Interest, rentals, etc., including Manhattan guarantee	6,222,328	6,159,073
Net corporate income....	2,825,557	3,276,937
Dividends, six months....	1,575,000	1,575,000
Surplus	1,250,557	1,701,937
Passengers carried.....	328,862,042	320,560,226

The increase in operating expenses is largely due to extraordinary expenditures, the result of changes in subway equipment made necessary in connection with the operation of ten-car express and six-car local trains.

PORTO RICO RAILWAY & LIGHT COMPANY.

The Porto Rico Railway & Light Company net earnings for the year ended December 31, 1910, amounted to $267,758, a gain of thirty-seven and three-fourths per cent; surplus after charges, $100,310, equal to 3.34 per cent on the common stock.

NATIONAL CARBON COMPANY.

The National Carbon Company has issued its report for the twelve months ended December 31, 1910. The income account compares with the eleven months ended Dec. 31, 1909, as follows:

	1910	*1909
Net earnings	$1,303,296	$1,211,438
Preferred dividends	315,000	†236,250
Balance	‡988,296	975,188
Common dividend	§330,000	261,250
Balance	658,296	713,938
Depreciation, etc.	285,893	296,323
Surplus	372,403	417,615

*Eleven months ended December 31, 1909.
†Includes three quarterly dividends only.
‡After allowing for seven per cent on $4,500,000 preferred, the balance is equal to 17.9 per cent on $5,500,000 common stock as compared with 16.3 per cent previous year.
§In addition, an extra dividend of fifteen per cent ($825,000) paid on common stock, November 7, 1910, out of profit and loss.

TOLEDO RAILWAYS & LIGHT.

The Toledo Railways & Light Company reports for the year ended December 31, 1910, compared as follows:

	1910	1909
Gross	$2,985,232	$2,820,349
Expenses	1,868,450	1,714,519
Net	1,116,782	1,105,830
Charges	926,381	778,286
Surplus	190,401	327,554

EDISON COMPANY OF BOSTON.

The report of the Edison Electric Illuminating Company of Boston for the month of February and eight months ended February 28 compared as follows:

	1911.	1910.
February gross	$ 515,933	$ 453,111
Expenses	190,255	185,494
February net	325,678	267,617
Eight months' gross	3,550,646	3,176,887
Expense	1,483,143	1,420,117
Eight months' net.....	2,067,503	1,756,770

SYRACUSE RAPID TRANSIT.

The report of the Syracuse Rapid Transit Railway Company, for the quarter ended December 31, 1910, compares as follows:

	1910.	1909.
Total operating revenue ...$	400,036	$ 368,013
Total operating expenses..	266,749	268,410
Net operating revenue	133,287	99,604
Taxes accrued	17,505	18,680
Operating income	115,782	80,923
Surplus after charges.....	37,162	4,115

FEDERAL TELEPHONE & TELEGRAPH.

The Federal Telephone & Telegraph Company report for the year ended December 31, 1910, compares as follows:

	1910.	1909.
Gross earnings .....$	889,061	$ 763,820
Expenses and taxes.....	371,866	354,559
Net earnings	517,195	409,261
Charges	249,756	236,847
Surplus	267,439	172,415

There is deducted from surplus $100,000 annually as a depreciation reserve and the balance is carried to surplus account.

STONE & WEBSTER PROPERTIES.

The following gas and electric companies under the management of Stone & Webster report earnings for January, which compare as follows:

BLACKSTONE VALLEY GAS AND ELECTRIC COMPANY.

	1911.	1910.
Gross earnings .....$	113,030	$ 96,529
Net earnings	61,433	47,511
Surplus over charges.....	31,235	18,144

DALLAS ELECTRIC CORPORATION.

Gross earnings .....$	139,374	$118,721
Net earnings	57,182	37,969
Surplus over charges.....	29,759	11,562

EL PASO ELETRIC COMPANY.

Gross earnings .....$	61,769	$ 57,958
Net earnings	27,807	28,469
Surplus over charges.....	19,560	19,836

GALVESTON-HOUSTON ELECTRIC COMPANY.

Gross earnings .....$	111,166	$ 96,631
Net earnings	43,019	29,017
Surplus over charges.....	18,325	5,875

JACKSONVILLE ELECTRIC COMPANY.

Gross earnings .....$	52,765	$ 46,880
Net earnings	25,158	21,904
Surplus over charges.....	14,904	12,681

NORTHERN TEXAS ELECTRIC COMPANY.

Gross earnings .....$	124,009	$105,849
Net earnings	54,877	44,715
Surplus over charges.....	30,394	26,525

PUGET SOUND ELECTRIC RAILWAY.

Gross earnings .....$	142,251	$144,368
Net earnings	23,292	38,544

THE SEATTLE ELECTRIC COMPANY.

Deficit after charges.....	25,021	11,691
Gross earnings .....$	478,729	$467,700
Net earnings	202,059	157,309
Surplus over charges.....	91,655	51,661

TAMPA ELECTRIC COMPANY.

Gross earnings .....$	53,224	$ 53,361
Net earnings	24,548	23,052
Surplus over charges.....	18,466	18,485

WASHINGTON RAILWAY & ELECTRIC.

The Washington (D. C.) Railway & Electric Company has issued its pamphlet report for the year ended December 31, 1910. The income account compares as follows:

	1910.	1909.
Gross earnings .....$	4,123,560	$4,080,064
Operating expenses	2,151,828	2,110,579
Net earnings	1,971,731	1,969,485
Other income	23,310	10,602
Total income	1,995,041	1,980,087
Fixed charges	1,280,398	1,230,292
Balance	714,643	749,795
Preferred dividends	425,000	425,000
Surplus	*289,643	324,795
Common dividends	130,000	.....
Surplus	159,643	324,795

*Equal to 4.46 per cent on $6,500,000 common stock.

NASHVILLE RAILWAY & LIGHT.

The report of the Nashville Railway & Light Company for the month of December and twelve months ended December 31, 1910, compares as follows:

	1910.	1909.
December gross .....$	170,372	$ 159,277
Expenses and taxes.....	70,950	94,379
December net	99,422	64,898
Charges and depreciation...	38,431	37,694
December surplus	60,991	27,204
Twelve months' gross.....	1,832,465	1,724,380
Expenses and taxes.....	1,030,026	1,013,883
Twelve months' net.....	802,438	710,497
Charges and depreciation...	457,287	445,867
Twelve months' surplus...	345,151	264,630
Dividends	125,000	125,000
Surplus	220,151	139,630

New York Edison Development.

In 1910 the New York Edison Company gained more than 1,000,000 fifty-watt equivalents over the new business of the preceding year. The new business amounted to 3,690,187 fifty-watt equivalents, against 2,643,113 in the preceding year, or almost a forty per cent increase. There were above 185 times as many new contracts signed in 1910 as the total business of the Company in 1883.

Allis-Chalmers Exceeds Records for February.

Bookings of the Allis-Chalmers Company in February were almost double the record in January and, with very few exceptions, were larger than in any previous month in its history. From August last to January, inclusive, new business averaged fifty per cent less than in the corresponding previous period, but for the month just closed the record was approximately fifty per cent better than in 1910.

Operations at the company's plants now average about sixty per cent of capacity, which, owing to extensions made during the past three years, is equal to between seventy-five per cent and eighty per cent of what was formerly considered normal.

New Electrical and Mechanical Apparatus and Appliances.

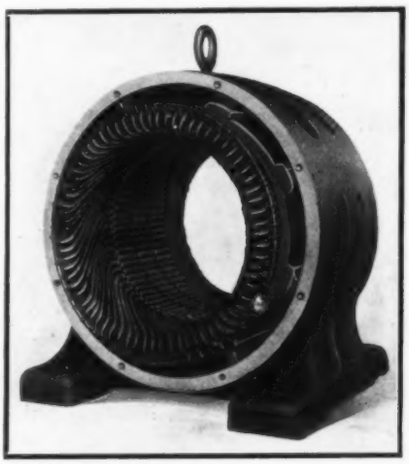
Alternating-Current Motor for Elevator, Crane and Similar Services.

The alternating-current slip-ring induction motor has been used with very satisfactory results in severe, varying-speed, reversing service, since its simplicity of structure, the absence of complicated parts and its operating characteristics adapt it admirably for this purpose. Heretofore modified standard machines have been employed for work of this kind, but it is evident that very much better results can be obtained with a motor specially designed in every detail.

With this in view the Westinghouse Electric & Manufacturing Company has recently placed on the market the type MW motor, a new alternating-current, slip-ring induction motor built especially for operating cranes, elevators, mine hoists, contractors' hoists, turntables, etc. This motor possesses features which are the result of twenty years' successful experience in designing direct-current mill, crane and elevator motors and alternating-current induction motors. The construction is exceptionally strong in order to withstand the heavy stresses of this service; the starting torque and overload capacity are high, and the motor is capable of developing maximum power for given dimensions. In operation it is practically noiseless, which is essential for elevator service.

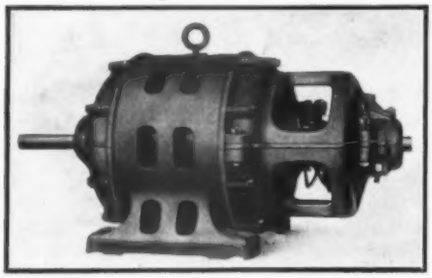
The construction of the frame, brackets, bearings and shaft is the same as that of the Westinghouse type MS motor, which has been used so successfully for the past three years in heavy steel mill duty. The frame is a massive cylindrical casting with large supporting feet and numerous openings for ventilation. The stator coils are heavily insulated, form-wound, and laid in open slots. The brackets are so designed that they give rigid support to the bearings; they are machine split in all except the three smallest sizes.

The rotor is of comparatively small diameter, so that it has low fly-wheel effect and is easy to brake; it is perfectly balanced and the windings are securely fastened in place. These features make the rotor especially adapted for frequent starting, stopping and reversing. The collector rings are inside the front bearing housing. The shaft is made of axle steel and is very heavy. The bearings are large babbitt-lined iron shells.

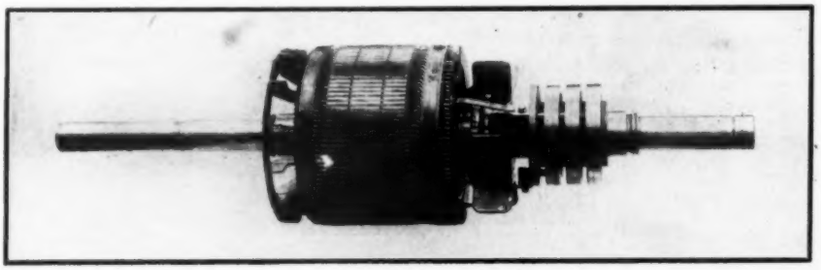


STATOR.

Convenience of repair has been an important consideration in the design of these motors. Removal of the upper half of either bracket gives access to the bearings and the interior of the motor without disturbing brushes or connections. The shaft can be removed and replaced without disturbing the rotor windings. The bearings can be readily relined; and the construction of the coils and the manner in which they are laid in the slots permit ready renewals. All parts are standard, and many of them, such as brackets, bearings, oil rings, brushes, brush holders, etc., are interchangeable between several frame sizes. The motors are made in a number of capacities ranging from five to 300 horsepower, and in several speeds.



ALTERNATING-CURRENT SLIP-RING INDUCTION MOTOR COMPLETE.



CONSTRUCTION OF ROTOR.

New Automatic Fire-Alarm System.

Patents have been secured by the International Electric Protection Company, New York, N. Y., covering an ingenious automatic fire-alarm system known as the "Air Alarm" that embodies a number of unique features.

The means of detecting the presence of the fire is the expansion of the atmosphere itself—the instantaneous result from exposed flames. This is accomplished as follows: A small continuous alloy tube is distributed on or near the ceilings of the building to be protected. The diameter of this tubing, which is one-eighth of an inch, and the fact that in most cases it is only necessary to extend it once around the ceiling or moulding, renders it in no way objectionable, and, in fact, in most cases, entirely invisible. Each end of this tube terminates in a small case, four inches square, containing an air chamber, a diaphragm, an electrical contact and a small vent for air leaks.

Several thousand feet of this continuous tubing may be attached to a single pair of these cases, and in most instances this amount of tubing will prove sufficient to give complete protection to one floor of a building.

The operation of the apparatus, above described, is as follows: Any

change of temperature, whether atmospheric or from natural means, such as steam pipes, stoves, etc., will cause the air in the room, and consequently that in the tubing, to slowly expand. The expanded air in the tubing is projected to the ends of same, at which points it escapes through the vents in the air chambers. These vents, or air leaks, are so adjusted as to allow for the escape of any air expansion in the tubing which will result from natural heat sources.

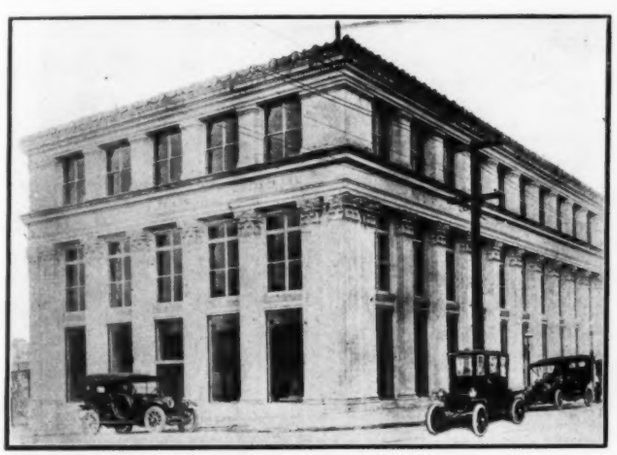
In the event of a fire, however, the exposed flames cause a sudden rapid rise of temperature on the ceiling, which is much more extreme than can be obtained in any other way. The resultant expansion of the air in the tubing is correspondingly great, and when this expansion reaches the air chambers at the end of the tubing, the air vents in same have not sufficient capacity to relieve the sudden and greatly increased pressure. This pressure is therefore exerted against the walls of the air chamber. As the diaphragm forms one of these walls, and the only flexible one, it is forced outward by this additional pressure, and in so doing closes the electrical contact whose circuit operates the apparatus which sends in the alarm to the fire department.

Another problem which has been solved by the "Air Alarm" is that of instant notification of any accidental damage occurring to the system. This is accomplished by running a small insulated wire through the tubing and connecting the circuit thus formed to its suitable relay. If the tubing is cut or crushed, the wire inside it becomes severed or grounded against the wall of the tubing, causing the relay to fail and sending a signal at once to the "Air Alarm" office, notifying them that that particular section of the system has been damaged.

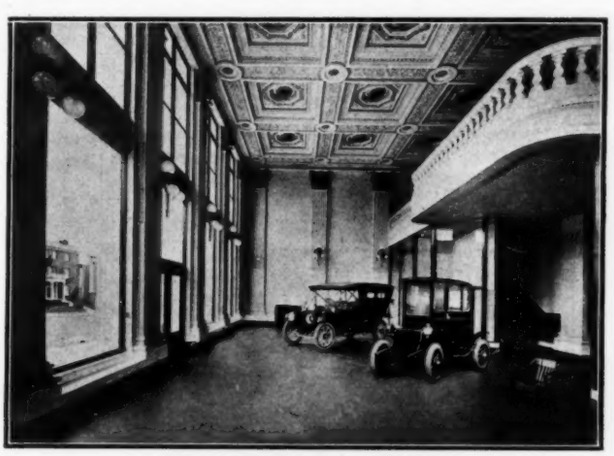
Nevertheless, the whole equipment is said to be practically accident proof, as any damage to its wires or tubing, while immediately sending a trouble signal, does not interfere with the subsequent transmission of fire signals. Damage to the transmission system automatically "throws in" a second path for the fire signals, while a cut or crush of the tubing does not prevent the subsequent immediate detection of an incipient blaze, owing to the fact that there is a diaphragm on each end.

Handsome Automobile Salesroom.

In the accompanying illustrations are shown exterior and interior views of what is said to be one of the handsomest automobile salesrooms and garages in the country. This garage is owned by Cuyler Lee, the San Francisco representative of the Packard gasoline car and the silent Waverley electric.



EXTERIOR OF SAN FRANCISCO GARAGE.



INTERIOR OF NEW GARAGE.

The Waverley Company states that numerous Packard representatives in different parts of the country have made contracts during the present year to represent the Waverley, as the two cars have been found to appeal to much the same set of people, and the man who has been accustomed to talking Packard finds it easy, as a rule, to present the selling points of the Waverley in a convincing manner.

It is especially true that handsome and dignified appointments like those with which Cuyler Lee has surrounded his establishment are important aids in selling these automobiles.

Western Electric Black-Enamel Wire.

Before the Western Electric Company offered its black-enameled wire to the open market it gave its product a four years' trial in the manufacture of its own apparatus. Black-enameled wire is now used extensively in the magnetic coils of Western Electric telephone apparatus and, it is claimed, is being used with great success as well by many other large manufacturers of electrical apparatus.

Prior to the development of black-enameled magnet wire attempts had been made to produce a satisfactory substitute for silk insulation. These were not successful, as the product either did not possess many of the essential features of satisfactory insulation, or it was not such that it could be manufactured commercially. Black-enameled wire is now offered to the market by the Western Electric Company and has been tested under the severest conditions. This wire is no longer an experiment or a theory.

It is claimed for this wire that while the black-enameled insulation is only .0002 inches to .0004 inches in thickness, it is so elastic that when the wire is stretched to the breaking point the enameled insulation does not break until the wire itself gives way. It will withstand the ordinary atmospheric corrosives and the severe atmospheric conditions of shops, factories, tropical climates and the sea coast indefinitely. It is not injured by indefinite exposure to temperature of 250 degrees Fahrenheit. It cannot be removed from the wire by the ordinary solvents, and the wire can be handled as easily and successfully as a silk-insulated wire.

One of the great advantages claim-

ed for black-enameled wire is its small diameter as compared with that of single silk or cotton-insulated wire. The winding space (for a specified number of turns) saved by black enameled wire over single silk No. 34 B. & S. wire is twenty-five per cent.

Large Bronze Casting.

The accompany illustration shows an interesting and rather exceptionally large bronze drum casting. The drum is 12 feet long, 5 feet in diameter, and is used as the drying surface in a large vacuum rotary drum dryer. The drums are generally made of dense air-furnace iron, but in this case it was necessary to use a high quality bronze drum due to the fact that the vegetable extract to be dried on the drum would become discolored if it came in contact with the iron.

The mold for this casting was swept up in dry sand, the core being swept up in loam. When the casting was poured, the mold was in a vertical position thus accounting for the very clean surface free from any blow holes. It required 16,000 pounds of metal to pour the casting and on account of this large quantity, it was necessary to melt the metal in a forty-eight-inch cupola.

MAMMOTH BRONZE CASTING.

The practice of melting bronze in a cupola is unusual, but the Buffalo Foundry & Machine Company, which made the casting in question, has been very successful in using this practice.

Solenoid-Operated Valves.

In industrial plants the solenoid has been used for many years for the operation of contactor and clapper-type switches, with solenoid switches and automatic and remote-control apparatus, but a new and uncommon application is made of the solenoid in a solenoid-operated valve shown in the illustration and recently put on the market by the Cutler-Hammer Manufacturing Company, Milwaukee, Wis. The construction employed permits of the placing of the plunger inside the piping system and entirely eliminates stuffing-box friction. The energizing of the coil, for which only a very small current is required, lifts the solenoid plunger through a short free travel, unseating the valve by a hammer blow. After the valve is started the pressure becomes nearly balanced. The coil circuit can be run wherever desired, so that the valve can be operated from any location or series of locations, according to the arrangement.

SOLENOID-OPERATED VALVE.

One application of this device is in connection with double-acting compressors, with which considerable trouble is often experienced in starting under compression. The solenoid-operated valve can be employed to automatically control a by-pass so that pressure can be released from the compression cylinder in starting, thus preventing compression. When the desired speed has been reached the by-pass is automatically closed, loading the compressor.

These devices are also adapted for numerous uses in hydraulic or pneumatic systems; with self-starters; for remote control of valves used for setting the brakes in a pneumatic-brake control system, etc. When arranged with a thermostat in a heating system they can be made to automatically control the flow of steam as desired. In signal systems where air-operated whistles are used these valves save piping and enable the ready control from a central location. In garages the air in compression tanks used for inflation of tires can be controlled by these devices with operating switches placed where convenient.

The valves are built in four standard sizes, three-eighth, one-half, three-quarter and one inch, threaded for standard iron pipe, and having an area of opening approximately equal to that of pipe of the same rated size. The standard coils are Cutler-Hammer Manufacturing Company's standard No. 3, No. 5 and No. 6 Varley coils (except for special sizes), wound for voltages of 115, 230 and 500.

Western Electric Auto Starters for Induction Motors.

A new line of alternating-current starting devices for use with squirrel-cage induction motors, and known as the "Western Electric" Hawthorn auto starters, has just been placed on the market.

AUTO STARTER, SHOWING OVERLOAD AND NO-VOLTAGE-RELEASE RELAYS.

This line of auto starters has for its features a no-voltage release, relay protection from overloads and a fool-proof switch. They are made for standard two and three-phase circuits and in

both wall-suspension and floor types. The core and windings, the cable clamp and switch are assembled in a substantial iron case. Each phase is provided with an inductive winding on separate legs of a laminated core, each winding being provided with several taps, in order that the auto starter can be adjusted to individual starting requirements. As all parts are readily accessible, these taps can be easily changed.

Perhaps the most important feature of this auto starter is the fool-proof switch. This switch, which is oil-immersed, is located at the bottom of the case, which arrangement permits of the removal of the inclosing oil tank for inspection or removal of the oil or contacts without taking the auto starter

FIG. 1.—UNIT NO. 635.

from its mounting or disconnecting any of the leads.

The no-voltage release, consisting of an iron-clad solenoid with a movable core, shunted across the power line, is a simple device which opens the starter switch when the voltage drops below an allowable low-voltage value for which the release is set. This causes the starter switch to return to the "off" position and disconnects the motor from the circuit.

These auto starters are provided with a flat fuse block, on which are mounted cartridge-type fuses separated by barriers. These fuses are connected on the running side of the starter circuit, and are not in circuit when the auto-starter switch is in the "starting" position. If preferred, an overload-release panel can be substituted. The overload release consists of two solenoids with movable cores, which at a predetermined value of line current pick up and open-circuit the no-voltage release.

NEW FEDERAL ELECTRIC APPARATUS.

HIGH-CANDLEPOWER TUNGSTEN UNITS.

The Federal Electric Company, Chicago, Ill., is placing on the market the high-candlepower tungsten units

FIG. 2.—UNIT NO. 640.

shown in the accompanying illustrations, which the company states are specially designed and proportioned to give efficient distribution of light with the high-candlepower tungsten-filament lamps. Economy of operation is also a factor which is claimed for all of these units.

In Fig. 4 is shown unit No. 636 which is designed particularly for 500-watt tungsten lamps. This unit has a twenty-inch glass-bowl shade with a ten-inch opening and a spun-brass dome ten and one-half inches in diameter. It has a six-inch white-porcelain enameled-steel disk wired with a large-base socket. The unit is suspended by a combination one-inch stem and a five-

FIG. 3.—UNIT NO. 637.

sixteenths inch ornamental chain. The standard finish is brush brass.

Unit No. 637, shown in Fig. 3, is a ceiling unit and is equipped with a twenty-inch glass-bowl shade with a ten-inch opening. It has a ten-inch white-porcelain enameled-steel disk, wired, and is equipped with a large-base socket for 500-watt tungsten-filament lamps. The brass band or canopy is twenty-two inches in diameter and six inches high.

Fig. 1 is a view of unit No. 635, which is also designed for 500-watt tungsten-filament lamps. This fixture has a twenty-inch black-porcelain enameled-steel shade and spun-porcelain enameled-steel dome, seven inches in diameter and five inches high. It is equipped with a large-base socket. The stem, of one and one-eighth inch iron pipe, is eighteen inches long and is painted black; with ornamental cast-iron ceiling base. Fig. 2 is known as unit No. 640. The reflector is sixteen inches in diameter and is white-porcelain enameled inside and out. The

FIG. 4.—UNIT NO. 636.

length overall to the bottom of the reflector is thirty inches.

FEDERAL KITCHEN CABINET.

The Federal kitchen cabinet, shown in Fig. 5, is designed to accomplish by means of electricity the countless mechanical operations of cooking and preparing food. By it power is supplied for the many mechanical operations of cooking and preparing the food for the table, and at the same time providing all the well known advantages of the modern kitchen cabinet which modern domestic science is introducing into every up-to-date household. The power, supplied by an eighth-horsepower motor located in the base of the cabinet, is transmitted to the shaft head on the table-bed, where it is available for use at either of the shaft ends. The power is turned on by a switch at the back of the cabinet. The motor is in a special compartment where it cannot be tampered with, become clogged by dirt or

water, or cause any injury to persons unfamiliar with such machinery. The revolving ends of the shaft arms are protected by swivel collars, making it impossible for them to catch or tear the clothing or fingers of the user even when running at full speed. All cogs and gears on the various pieces are protected by guards, to prevent accident.

The various pieces, eleven in number, which make up the complete equipment of the Federal kitchen cabinet are kept when not in use on the racks in the lower part of the cabinet, where they are easily accessible upon opening the two doors. They comprise a bread mixer, cake mixer, egg beater, vegetable slicer, coffee grinder, meat cutter, lemon grater, cherry pitter, knife sharpener, knife polisher and ice-cream freezer.

The cabinet is well and substantially made of oak heavily varnished. It is supplied only in standard golden oak finish, which has been found to harmonize with the majority of modern kitchen interiors and furnishings. The top of the table is covered with heavily nickel-plated sheet metal, which also extends back beneath the power arms and about six inches up the back wall of the cabinet. The metal brackets supporting the wooden shelves are also heavily nickel plated. This makes the top of the cabinet impervious to water and easily cleaned.

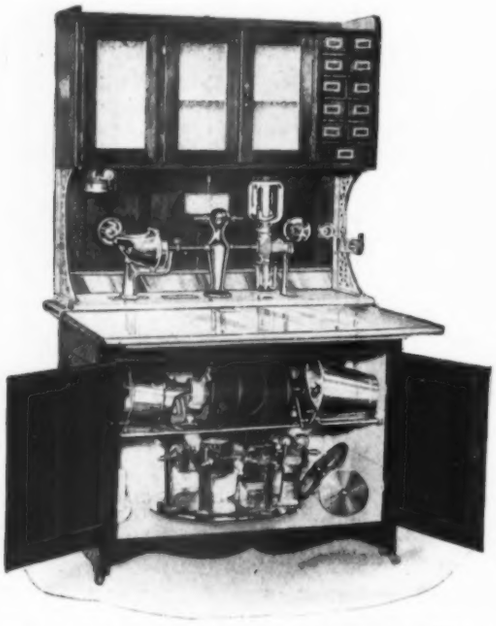


FIG. 5.—FEDERAL ELECTRIC KITCHEN CABINET.

An Improved Induction Watt-Hour Meter.

The Sangamo Electric Company, Springfield, Ill., has brought out an improved form of induction watt-hour meter which will be known as the type H. This meter, in common with all induction types, employes the well-known rotating-field principle discovered by Ferraris, which depends upon the interaction of two or more magnetic fields of different phase, so related and located with respect to each other as to produce a rotating field acting upon a movable low-resistance armature.

The simple field arrangements characteristic of the well-known Gutmann meters with the additional improvements suggested by ten years' broad experience in the meter art have been incorporated, thus securing a construction which will insure high initial and permanent accuracy.

FIG. 1.—SANGAMO WATT-HOUR METER.

The complete meter is shown in Figs. 1 and 2, the latter with cover removed, and the principal elements indicated. Figs. 3 and 4 show the main grid removed from the base, giving a clear idea of the structural features.

The moving element consists of a light aluminum disk mounted on a short shaft, the entire system weighing eighteen grams. The disk is swaged under heavy pressure, rendering it very stiff and rigid, effectually resisting the bending effects of accidental blows or of the most severe shortcircuits. In the arrangement of the disk, shaft and bearings some very novel and valuable features, both in the pivots and the bearings, have been incorporated. The upper pivot is made of highly-tempered steel wire, and of such diameter to be quite flexible in the length between the top of the shaft and the bearing in which it rotates. This guide ring which has its bearing hole "olioed" and burnished, has a long brass sleeve closely surrounding the upper pivot of the spindle, so that any blow against the moving system, caused by accident or shortcircuit, will slightly deflect the shaft until the steel pivot touches against the side of the shell.

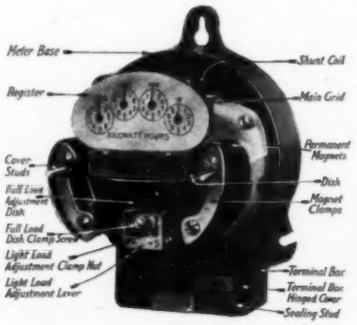


FIG. 2.—DETAIL PARTS.

FIG. 3.—SERIES COILS AND GRID.

FIG. 4.—SHUNT COIL.

The lower pivot arrangement, one of the most important features of the moving system in any induction meter, is entirely new. It consists of a hardened polished steel-wire tip, having both ends rounded and polished. This tip slips friction tight into a hole drilled in the lower end of the brass shaft split so as to compress on and firmly hold the pivot. When one end of the pivot has become worn or injured, it can be easily withdrawn, reversed, and when pushed in gives an entirely new pivot on the other end.

The lower bearing differs entirely from that used in any previous forms of induction meters, consisting of a ring stone and end stone of high-grade

sapphire instead of the usual cup jewel used in other meters. It is the same construction as used in all watch bearings. The bearing adopted offers several advantages over the cup jewel as it is possible to obtain absolutely perfect end stones, easily inspected merely by reflection of light from the flat surface, so that the least flaw is immediately detected, whereas any one who has ever tried to inspect or test a cup jewel knows how difficult it is to absolutely determine the presence of a flaw in the bottom of the cup, unless the defect is very bad.

As is well known, the shunt or potential coil of an induction meter occasionally breaks down or burns out, due to abnormal line conditions or accident. In such cases the replacement of a coil is a difficult matter in the average meters. With the new design replacement is easily made, the entire shunt magnet with its coil being held to the base by two dowel pins and four screws, enabling removal as a unit. A new core and coil may thus be substituted without removing and replacing laminations, as is ordinarily necessary. As the iron core is of small value, compared with the coil, it is far better to furnish a complete core and coil unit for replacement, rather than the coil alone—hence in the type H meter there can be no occasion to remove the core from a defective coil.

The laminated core has but a single air gap, in which the disk rotates, insuring perfect uniformity and alinement and eliminating magnetic leakage. The laminations forming the core are laced into the shunt coil, and then subjected to enormous hydraulic pressure, the rivets being set at the same time, so that the whole forms a compact non-vibrating unit, eliminating humming.

The series coils are mounted on a laminated-iron structure having a laminated return plate forming an air gap in which the disk rotates. The design of the curved magnetic return plate, with laminations placed edgewise to the field below, gives a maximum radius of action for both the series and shunt fields. The gap of the shunt field in which the disk rotates, projects in between series magnet poles, the return plate curving so as to clear the shunt magnet.

Full-load adjustment is effected by simply raising or lowering a micrometer-supported magnetic disk shunt in proximity to the permanent magnets. This is the logical method and corresponds to long established micrometer adjustments in watches and clocks. On each side of the bracket, carrying the lower bearing is the light-load adjusting lever stamped "F" and "S," indicating that when the lever is moved in the direction marked "F" the meter will run faster on light load, and when moved towards "S" will run slower.

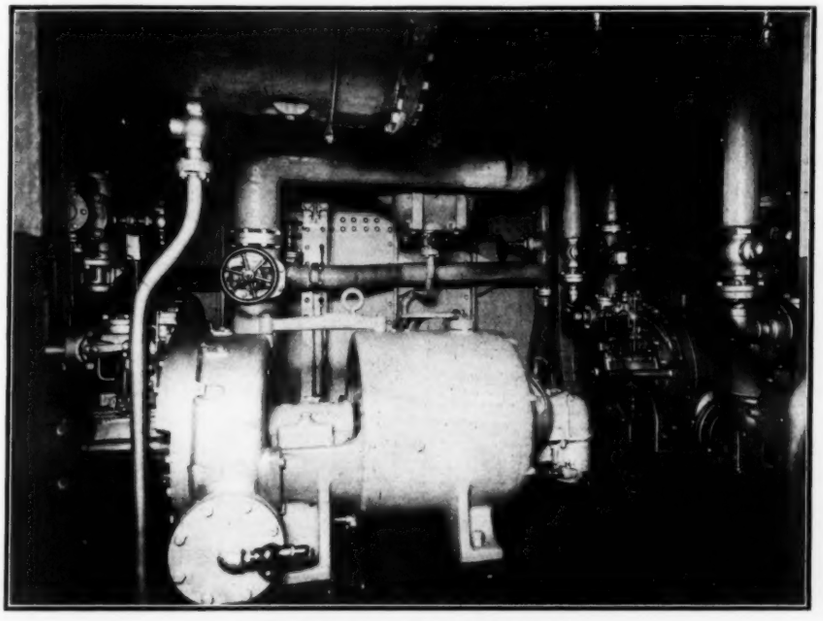
In the type "H" meter short-circuit effects on the permanent magnets are negligible as the heavy laminated return plate of the series coils offers an effective closed path for the surplus flux. The shape of this magnetic plate is such that the spreading lines of force, under short-circuit conditions, naturally tend to travel along the curved lines defined by the laminations.

Curtis Turbines for Lake Steamer.

The palatial steamers of the present day are equipped with every convenience demanded by the high-class patronage which they enjoy. This means elegantly appointed staterooms, luxuriously furnished, the highest class of service, and last and not least, electric lights. Any other method of lighting than by electricity is out of the question. Its feature of safety, economy and the fact that it does not vitiate the air, commend it as being the form of lighting best suited to this service.

The illustration shows three General Electric steam turbines, aggregating 105 kilowatts installed on the steamship *Alabama,* owned by the Goodrich Transportation Company of Chicago, and now in service on Lake Michigan. On a boat, economy of space is imperative and a glance at this turbine equipment shows that compactness is a feature of this installation, each unit occupying a space of 3 feet 4 inches by 7 feet with 3 feet headroom. They are single-stage condensing turbines designed for operation with a steam pressure of 150 pounds, and are direct-connected to thirty-five-kilowatt 125-volt direct-current generators.

These sets furnish power for the searchlight, for lighting the boat, and charging a storage battery which is used for emergency lighting.



CURTIS TURBINES ON THE ALABAMA.

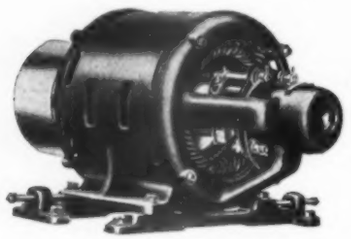
Richmond Slip-Ring Polyphase Motors.

An appreciation of the increasing demand for satisfactory variable-speed polyphase alternating-current motors has led the Richmond Electric Company, Richmond, Va., to place on the market a full line of machines of this nature in sizes from one-fourth to seventy-five horsepower, inclusive. These motors have been found very satisfactory for the operation of printing presses, machine tools, freight and passenger elevators, cranes, hoists, ventilating fans, etc.

The Richmond slip-ring polyphase motors, which are known as type HF,

correspond very closely in operating characteristics to shunt-wound direct-current motors with armature control. The standard form of construction employed in all the HF motors is shown in the accompanying illustration. It will be noted that these motors are well protected and at the same time sufficiently ventilated to permit of the motor carrying heavy loads continuously without an abnormal temperature rise. The very best material and workmanship are employed in their construction, and all parts are of heavy design for their rated capacity. The shafts are of sufficient size for the most severe service. These motors can be mounted on the side wall or ceiling by turning the end plates 90 to 180 degrees, so as to keep the oil wells in a vertical position. A substantial iron sub-base is furnished with the one-fourth-horsepower to three-horsepower motors, and rails with the five-horsepower to seventy-five-horsepower motors.

The stator frames are of cast iron and in one piece. The section is such that a rigid support is obtained for the laminations. The feet are broad, and the entire frame construction is such that there can be no springing. The laminations are of the highest grade electrical sheet steel, and are annealed after the slots are punched in the inner periphery. In this manner the effects of hardening of the steel, due to punching, are eliminated. The steel is especially treated during the process of annealing to eliminate the effects of aging. Before assembling in the stator frame each disk is japanned and baked. The stampings are then clamped in the stator frame under hydraulic pressure between heavy malleable iron rings. At each end of the laminations is a fiber disk with slots of the same size as in the steel punching. These disks are an additional protection to the coils where they come out of the slots. The inside diameter of the stator punchings is ground on a special machine, thereby insuring an accurate air gap. The partly closed slots are then lined with fiber and mica tubes. The stator windings, which are liberally designed as to carrying capacity, are then placed in position, a hardwood key is driven in, thus closing the top of each slot, and holding the coil securely in its place. The coils are carefully taped, and the stator is dipped in a high-grade moisture and oilproof compound and then baked.



RICHMOND POLYPHASE MOTOR.

The rotors are built and ground in the same careful manner as the stators. In the smaller sizes the punchings are mounted directly upon the shaft and clamped under hydraulic pressure between malleable-iron heads. In the larger sizes the punchings are mounted on spiders and clamped between malleable-iron rings.

Modern Plant of The Morris Iron Co.

The Morris Iron Company, successor to the Elmer P. Morris Company, Frederick Iron Works, and Montrose Iron Works, is reconstructing its plant at Frederick, Md., for supplying ornamental posts, castings, and out-door lighting specialties. The plant will consist of seven buildings with a total floor space of some two and a half acres and will have direct connection with the Pennsylvania Railroad and the Frederick Railway.

The boiler and power house will be equipped with McEwan boilers and Harrisburg Corliss direct-connected engine and C. & C. dynamos. For lighting purposes a General Electric direct-connected 220-volt generator will be used. A New York air compressor, having a capacity of 300 cubic feet of free air per minute, will be installed for operating air hoists, chipping hammers and sand blasts.

The foundry will have a floor space of over 50,000 square feet for moulding purposes only, and connected with this will be the sand blasting, cleaning and chipping room. The foundry is now being equipped with electric traveling cranes, air and electric hoists, moulding machines and similar modern tools.

The machine shop will be 60 by 325 feet and will be equipped with traveling crane and twenty machines for handling all kinds of high-grade machine work. The pattern shop will adjoin the machine shop and will also be equipped with all modern tools. The pattern storage building will be 60 by over 200 feet and absolutely fire-proof.

The warehouse and shipping department is 60 by 175 feet with ample yard space. An industrial railway system will be installed throughout the entire plant.

The sales office will remain at 86 West Street, New York City, but the general offices will be installed in a two-story building which will include the drafting and designing department. When the plant is completed, between 250 and 300 men will be employed continuously.

In addition to the line of ornamental poles, brackets, and electric light and railway fittings, the company will supply small castings, such as building columns, plain and ornamental; machine-tool castings; grate bars; manhole covers, frames and a general line of aluminum, brass, grey iron and semi-steel castings.

New Connecticut Telephone.

The Connecticut Telephone & Electric Company, of Meriden, Conn., has just placed on the market a new type of battery-call telephone. This instrument is made up in a stamped metal case, highly finished in black. A new transmitter and hook of very high-class design have been added. This instrument, being a battery-call telephone, is not generally used for over 500 to 1,000 feet, as it is, of course, not possible to ring a battery bell over a longer line. While this telephone is sold at a very low price, it is unusually high grade throughout. It is designed particularly for two-line use, that is, between house and barn, offices in public buildings, etc.

NEW CONNECTICUT TELEPHONE.

Current Electrical News

COMMISSION NEWS FROM NEW YORK.

(Special Correspondence.)

Representatives of the New York Central & Hudson River Railroad Company appeared before the Public Service Commission, Second District, opposing the petition of the Hudson River and Eastern Traction Company for permission to begin construction of a trolley road from Sherman Park to White Plains. Five years ago the Board of Railroad Commissioners granted a certificate to the company for the building of its line between Ossining and Sherman Park. No construction has been started along this line.

Attorney William L. Visscher of the New York Central objected to the trolley because it practically parallels the New York and Harlem for a distance of seven miles and is from 100 to 500 feet away between Pleasantville and North White Plains. He said his company is now rendering adequate service through this territory and that there was no need for the electric road. In Pleasantville, he pointed out, that a part of the trolley route is on Vanderbilt Avenue, the fee of which is in the Central.

At places in North White Plains, Vallalla, Hawthorne, Kensico Cemetery and Sherman Park, Mr. Visscher stated the proposed line is in such proximity to the Central that the latter road would be put to additional expense in eliminating grade crossings.

The Public Service Commission, Second District, has served upon the Black River Telephone Company the complaint of the village board and citizens of Lowville, alleging that the rates now charged by that company in the village of Lowville are in violation of the terms of a franchise granted to the company. The franchise in question was granted in 1900 and provided for a rate of $15.00 per year for business places and not to exceed $10.00 per year for residences. The complaint alleges that the new tariff provides for rates in Lowville at a maximum of $3.00 per month for business houses and $1.75 per month for residences, scaled down to $3.00 per month for four-party business lines, and $1.25 for four-party residence lines. The company has been given twenty days in which to answer the complaint.

The Public Service Commission of the Second District has dismissed the joint petition of the Amsterdam Automatic Telephone Company and the New York Telephone Company for the approval of the transfer of the real estate, physical plant and property of the Amsterdam Company to the New York Telephone Company. In its ruling the Commission holds that it has no power either to consent to or forbid the transfer of the physical property of one telephone company to another, its jurisdiction being confined to controlling the franchise transfers.

Approval of the Commission has been obtained to the application for transfer by merger of the Jefferson County Telephone Company to the New York Telephone Company. The Commission also approves the taking over by the New York company of the Trumansburg Citizens' Telephone Company.

On the other hand, the Commission approves the transfer by the New York Telephone Company to the Otsego & Delaware Telephone Company of certain franchises of the Central New York Telephone & Telegraph Company. The New York Company has also received the sanction of the Commission to its transfer to the Allegheny County Telephone Company of franchises granted the New York & Pennsylvania Telephone & Telegraph Company.

Permission has been asked by the Oneida Railway Company for a 475-year franchise by which it may operate by third rail its passenger and express cars on the West Shore division of the New York Central between Utica and Syracuse. No more than half the capacity of this fifty miles right of way is to be used by the Oneida cars, for which it will pay the Central $130,000 a year.

Complaints filed with the Public Service Commission during February against the transportation companies of Greater New York number 126. Of these, sixteen were satisfactorily settled by the companies, without investigation by the Public Service Commission.

Complains against the transportation companies have decreased about one-third in three years, according to a report just issued by the Public Service Commission. In 1908, the first calendar year of the Commission's existence, more than 3,000 complaints were received. For the year 1910 the total was only 1,988 directed against thirty-five different operating corporations.

COMMISSION NEWS FROM WISCONSIN.

(Special Correspondence.)

The Commission has authorized the Lake Geneva & Lake Delavan Electric Company to issue $200,000 in stock and notes or bonds. The funds derived from the sale of the stock and bonds are to be used for the purpose of supplying the company with funds for paying organization expenses, and all the expense incident to the construction and equipment of a line of electric railway between the village of Walworth and the city of Delavan, all in the county of Walworth, Wisconsin.

That three persons do not constitute the "public" was determined by Judge E. Ray Steven in the Circuit Court of Dane County. The case is that of Sarah M. Cawker and others against the Railroad Commission of Wisconsin. The plaintiffs own and operate a heating plant in connection with the Cawker Building in Milwaukee which furnishes light, heat and power to the building. The plant was installed and maintained by the plaintiffs to meet their own demands, and finding that it created more heat and light than was necessary for their own use they entered into an agreement with three tenants to furnish them with what they would need. The question was as to whether this would amount to operating a public utility and thus be subject to the control of the Railroad Commission. It was held by the court that this would not constitute a public utility any more than it would if a man furnished his neighbors with water out of his well even if they paid for the same. The heating plant as well as the well was a necessity and if either provided a greater output than the owner needed he had a right to dispose of it if he could without coming under the control of the Commission. The court held further, "There is nothing in the legislative intent as expressed in the law or in the facts pleaded with relation to plaintiff's plant that would warrant the court in holding that the three persons or corporations to whom light, heat and power are furnished by the plaintiff constitute the public, within the meaning of the statutes." The Commission is expected to appeal the case to the Supreme Court.

The Commission has handed down its decision in the matter of the complaint of J. J. Lamb vs. Eastern Wisconsin Railway & Light Company, alleging that the fare zones established by the railway were discriminatory. The Commission made a valuation of the physical property of the company and also investigated the earnings and expenses of the company for a period of years. Tests of the consumption of current by the company's cars were made by O. M. Rau, superintendent of electric lighting for the Milwaukee Electric Railway & Lighting Company. These tests showed a consumption per car mile for city running of from 2.60 to 2.73 kilowatt-hours for fifty-horsepower, four-motor cars of twenty-nine tons and twenty-eight tons. The consumption per car hour was from 32.44 to 33.92 kilowatt-hours. For interurban running the tests showed a consumption per car hour of from 55.03 to 56.87 kilowatt-hours and from 2.21 to 2.23 kilowatt-hours per car mile. In conclusion the Commission stated that not only are the company's revenues too low to warrant any reduction in rates, but the zone system as at present in effect on the company's line is so arranged as to satisfy reasonably well the requirements of the general public.

The Bloomer Electric Light Company applied for permission to put into effect a minimum bill and to affect other changes and adjustments in the rate schedule. The Commission found upon investigation of the rates and services given by the company that the service was not adequate and the Commission insisted that the service be made reasonably adequate before any changes in rates would be authorized.

COMMISSION NEWS FROM NEW JERSEY.

(Special Correspondence.)

In the matter of the petition for the approval of leases of the Trenton Street Railway Company, the Trenton, Hamilton & Ewing Traction Company, and others to the Trenton & Mercer County Traction Company, the Board decided that it would approve the lease and would further, upon formal application, approve the issue of bonds to make improvements.

The inhabitants of Trenton petitioned the Board that the Trenton Street Railway Company be ordered to put its roadbed and overhead system in order and also to provide air brakes for its cars.

The Board ordered certain improvements to be made on a number of the company's lines, but found that the present equipment of brakes upon the city cars was adequate. In view of the absence of steep grades in the city, and the speed maintained for urban traffic, the Board considered the hand-brake equipment on these cars efficient and in accordance with good practice, and determined that in this respect the Trenton Street Railway Company furnishes safe and adequate service. The Board, however, found that the Trenton Street Railway Company fails to furnish safe and adequate service in the City of Trenton in that it operates cars that are not properly equipped with sand-boxes and ordered the installation of them.

A suggestion was made that the railway company should set up a depreciation account and that the work which was to be done should be paid for from that fund.

LIGHTING AND POWER.

(Special Correspondence.)

TIOGA, N. D.—A company has been organized to put in an electric light plant. C.

LETCHER, S. D.—The electric light plant here was recently completed and is now in service.

ALTUS, OKLA.—The new municipal electric light plant was put in operation a short time ago.

MALTA, MONT.—H. E. Wharton has applied to the Council for a franchise to install an electric light plant. C.

DRAPER, S. D.—The Council will grant a twenty-five-year franchise for the installation of an electric light plant. C.

BUFFALO, MINN.—The new municipal electric light plant, which was erected at a cost of $20,000, has been put in operation.

BARBERTON, O.—The Barberton Light & Power Company has been incorporated with a capital of $10,000 by Charles S. Johnson.

MOTT, N. D.—The village council granted a twenty-year franchise to J. Blaine Little for the operation of an electric light plant in this place. C.

TYNDALL, S. D.—The new electric light system at this place is about ready to be placed in operation. It was installed at a cost of $17,000.

MOBRIDGE, S. D.—A franchise has been granted to the Mobridge Electric Light, Power & Heating Company, to install an electric light plant. C.

TIMPSON, TEX.—The City Council will order an election to vote on the proposition of issuing $20,000 of bonds for constructing a water works system.

MANCHESTER, IOWA.—A vote will be taken March twenty-seventh on granting a franchise to Joseph Hutchinson for the installation of an electric light plant. C.

WASECA, MINN.—A vote will be taken at the April election on issuing bonds for $15,000 for the improvement of the electric light plant and the water-works system. C.

GOLIAD, TEX.—The Goliad Supply Company has been organized for the purpose of installing a water-works system, an ice factory and electric light plant at Goliad. D.

FLATONIA, TEX.—The Flatonia Ice, Water & Electric Light Company recently put its plant in operation. This replaces the installation which was burned several years ago.

MARTINEZ, CAL.—The great Western Power Company has been granted a franchise to erect lines and poles for distributing electricity in this city for lighting and power purposes. A.

FOREST GROVE, ORE.—The Independent Electric Company has been granted a twenty-five-year franchise for an electric power line in this city. Construction work will probably commence early in April. A.

HARRISBURG, ARK.—Morris Hayutin of this city has purchased the entire holdings of the stockholders of the Harrisburg Electric Light & Power Company and will spend several thousand dollars in improving the plant.

WHITE EARTH, N. D.—The White Earth Lighting Company has been incorporated with a capital stock of $10,000. The incorporators are Olaf M. Muss, Cornelius Hansen, Peter Herseth and A. B. Feiring, all of White Earth.

LOS ANGELES, CAL.—The Phoenix Lighting Fixture Company is about to erect a three-story brick building here. The plant is expected to be in full operation by the first of April. A manufacturing department is included in the plans. A.

WILLOWS, CAL.—The Peoples' Power Company has been organized in this city and, under contract with the Sacramento Power Company, will get its electricity from that company and operate in this and the northern part of Colusa County. A.

CINCINNATI, O.—The Logan Electric Company has incorporated with a capital of $25,000 to erect and operate power plants. The incorporators are W. F. Bevill, Charles Bennett, S. M. Bisant, Naman Jackson and Frank R. Hurst, all of Logan.

DEVILS LAKE, N. D.—A representative of eastern interests has investigated the electric light proposition and will probably install a new plant here with an investment of $50,000. The old plant is not equipped to meet the demands of the city.

PORTOLA, CAL.—The electric lighting company recently incorporated by C. H. Gardner has commenced work on the construction of its plant. Mr. Gardner, president of the company, believes that the plant will be in complete operation within five months. A.

REDWOOD FALLS, MINN.—The United States Senate has authorized the construction by the Minnesota River Improvement & Power Company, of two dams in the Minnesota River, one near the mouth of the Redwood River and the other located at Big Stone Lake. C.

MT. CARMEL, PA.—The new Lehigh Valley power house now under construction at Centralia is nearly completed and will be ready for operation in about one month. The machinery is being installed in a large cement building. This new plant will furnish power and light for all the Lehigh Valley collieries in the region, including the Packer No. 5 at Shenadoah and Sayre at Mount Carmel.

SANDUSKY, O.—For the third time within the past three months Mayor George T. Lekrer, of this city, has vetoed an electric lighting ordinance duly passed by the City Council. It is now thought certain that the council will pass the ordinance over the veto. H.

SACRAMENTO, CAL.—The Pacific Gas & Electric Company is planning a great system of water-storage reservoirs in Lake Valley. The Northern California and the Sacramento Valley companies are also extending their lines and reaching out for new business.

WILMINGTON, DEL.—The city probably will establish its own lighting plant within a short time. The plant will be built and equipped to generate enough power to furnish light for all city buildings and for a greater portion of the city streets. The water power at the command of the city will be utilized.

VERDI, NEV.—The Truckee River General Electric Company, which controls the power plants along the Truckee River, is now working on a new plant. This plant is to be larger than all the other plants along the river, and will supply power to the smelter which is to be built at Waubuska, and to mills, smelters and mines in other parts of the state.

HELENA, ARK.—The Helena Gas & Electric Company has been sold for $135,000 to a Philadelphia syndicate, which will immediately take charge of the property and which will also begin extensive improvements. The new owners have already secured a site for the building of the new power house and it is stated that $350,000 will be spent thereon.

FREEWATER, ORE.—The Pacific Electric Light & Power Company is constructing a power line which is to supply power for pumping water. The line commences at the Freewater substation and goes through the Hudson Bay country. There will in all be about thirty miles of line, and farmers along the route have subscribed for over 500 horsepower.

OROVILLE, CAL.—George H. Tully, H. B. Lind and M. P. Barnes, all of Sacramento, Cal., have purchased 90,000 inches of water on the Middle Fork of the Feather River. The purchasers are about to incorporate the Central California Hydroelectric Power Company and plan within three months to begin work on developing their recently purchased water rights. A.

DEERWOOD, MINN.—This village, Crosby and Cuyuna, the three chief-towns of the Cuyuna Range, are now illuminated by the Cuyuna Range Light & Power Company. The power house at Deerwood contains a 300-horsepower cross-compound Corliss engine and a 200-kilowatt generator. Frank B. Leason, formerly with the light plant at Staples, as the chief engineer.

BURLINGTON, N. C.—The Almanac Power Company, which was incorporated recently has organized to construct a hydroelectric plant on Haw River. F. L. Williamson of Burlington, is president and treasurer, J. Harvey White, of Graham, N. C., is vice-president, and Charles E. Menefee of Graham is secretary. The company has a capital stock of $300,000, and its main offices are at Graham.

MINNEAPOLIS, MINN.—The committee for the big civic jubilee to be held here next July has decided upon the illumination scheme. There will be six Corinthian pillars twenty-five feet in height and four feet square at base for each of the twelve blocks. From these will be looped ropes of incandescents to the ornamental street lights and festooned at street intersections. The pillars are to be surmounted by large clusters of lights. Z.

SCRANTON, PA.—Announcement has been made by the Scranton Electric Company that it proposes to spend $1,000,000 to make its plants in this city and vicinity second to none in the country. At present, through purchases from various companies that have started, the company is making use of several plants in this city. The generation of electricity is to be centralized in the suburban plant in Green Ridge and at the plant on the banks of the Lackawanna River.

ROSWELL, N. M.—The Roswell Gas & Electric Company of Roswell is rebuilding its electric power plant and enlarging its capacity with the view of providing power for irrigation pumping plants in this part of the Pecos River Valley. The Berrendo Farms Company will install sixty-five pumping plants, each of a capacity of 1,000 gallons per minute, all to be operated by electricity. The Roswell Gas & Electric Company will construct a system of transmission lines to cover the valley territory. D.

MINNEAPOLIS, MINN.—The health and hospitals committee of the City Council has recommended the purchase of a new engine and generator to cost $2,500, for use in lighting the city buildings adjacent to the crematory. It was decided to change from the direct to the alternating-current system. At a conference it was decided that the maximum steam capacity of the garbage crematory if developed and the investment of $50,000 in electrical and other equipment would net the city $17,000 annually and plans for introduction of a bill into the legislature authorizing the bond issue were discussed.

ELECTRIC RAILWAYS.

(Special Correspondence.)

ALBIA, IOWA.—Business men are planning for the construction of an interurban to Buxton. C.

BILLINGS, MONT.—It is reported that the Eastern Montana Electric Railway Company will build a line to Bear Creek. C.

MARSEILLES, ILL.—The Chicago, Ottawa & Peoria Interurban Railway has asked for franchise to operate its lines through the city. Z.

GALLIPOLIS, O.—The Gallia & Meigs Electric Railway Company has been incorporated with a capital of $50,000 by T. W. Jackson and others.

SALT LAKE CITY, UTAH.—The Payson Electric Railroad Company has applied for a franchise to build and operate an electric interurban road between this city and the town of Payson, Utah County. A.

BRECKENRIDGE, MINN.—The Breckenridge & Wahpeton Street Railway Company is planning the construction of several extensions of its lines including one into the lake region of Otter Trail County. C.

CORPUS CHRISTI, TEX.—The Corpus Christi Street and Interurban Railway Company of Corpus Christi has been granted a franchise by the City Council to extend its lines to suburban parts of the town. D.

OAKLAND, CAL.—The Oakland Traction Company has applied for thirty-five-year franchises on Clay Street, from San Pablo Avenue to Eighth Street; Market Street, from San Pablo Avenue to Fifty-fifth Street, Thirteenth from Washington to Market Streets, and Market from Thirteenth to Fourteenth Streets.

LOS ANGELES, CAL.—The Pacific Electric Railroad Company has agreed to lay tracks on the municipal docks in this city, at actual cost in addition to laying the connection tracks of its belt railing over the private right-of-way on Riverside Drive, connecting with the company's established lines. All this new work is to commence this month. A.

HENDERSON, KY.—Articles of incorporation have been drawn up for the Henderson Interurban Railway Company, which is to be organized with a capital of $10,000. The charter provides for the construction and operation of electric railways in Kentucky. It is proposed to build standard-gage electric railways between Henderson and Dixon, to Uniontown via Morganfield, and Henderson and Owensboro. The aggregate length of these lines will be about eighty-five miles. The incorporators of the company are E. F. Wheaton and F. M. Smith, of Nashville, and W. W. Cooper, of Smith Mills.

FT. WAYNE, IND.—The Ft. Wayne and Northern Indiana Traction Company has filed articles of incorporation with the Secretary of State. The capital stock is $8,000,000, divided equally into common and preferred stock. The organization is the consummation of plans to take over the Ft. Wayne & Wabash Valley Traction Company's interurban lines and the street railway lines of Ft. Wayne and Lafayette, and a general refinancing of the entire system. The articles of corporation provide for the construction of a new branch line from Ft. Wayne to Warsaw. Eleven directors are named, all residents of Indiana. The directors have elected officers as follows: President, Henry J. Bowerfield; vice-president, J. H. Baberly; secretary, A. H. Mohr; and treasurer, H. E. Mordemark. The transfer of the property was made March 1, since which time the new financial interests have been in control. S.

TELEPHONE AND TELEGRAPH.

(Special Correspondence.)

APPLETON, WIS.—The Fox River Valley Telephone Company is about to rebuild its entire plant. P.

BACKUS, MINN.—The Backus Rural Telephone Company is planning improvements and extensions. C.

DEER RIVER, MINN.—Farmers have organized to secure a telephone line from Deer Lake to town. C.

CORSICA, S. D.—The Farmers Telephone Company is about to begin the construction of another line. P.

DENNISON, IOWA.—The East Boyer Telephone Company will increase its capital from $5,000 to $10,000 and will also extend its lines. C.

BLUFFTON, MINN.—The Leaf River Rural Telephone Company is planning the construction of a telephone line north of here. C.

LONG PRAIRIE, MINN.—George Langton and others of Hartford are organizing a company to build a telephone line north of here. C.

CHICO, CAL.—John Leaper has applied for a telephone and telegraph franchise in this city, on behalf of the Home Telephone Company.

GREAT FALLS, MONT.—The Bell Telephone Company is expending $26,000 on the extension of its lines to Lewistown and the Judith section. C.

BRAINERD, MINN.—The National Light, Heat & Pomer Company will carry out the franchise granted to the Toltz Engineering Company, of St. Paul. P.

WYLIE, MINN.—The Wylie Farmers' Telephone Company has been incorporated with a capital of $10,000, by Leon Huot, Fred Gothm and F. Regis Huot.

KERMAN, CAL.—The Vineland Telephone Company with J. C. Ashlin as president, and R. S. Elliott, as secretary, has been granted a franchise to erect telephone wires in this city. A.

PEGGS, OKLA.—The Spring Creek Telephone Company has incorporated with a capital of $2,000. The incorporators are D. E. Robinson, C. A. Downing, C. W. Bradshaw and C. A. Wilson.

VISALIA, CAL.—The Alpaugh Telephone & Telegraph Company has been incorporated here by N. L. Wilson, T. G. Adams, C. E. Timmons, W. F. McFarland and M. G. McNeely, with a capital stock of $25,000.

SOUTH BEND, IND.—The Central Union Telephone Company intends to spend $32,000 in Mishawaka, Ind., in improvements and extending its wires to parts of the city heretofore not covered by the company. Two carloads of cables have arrived and the company has a large force of men at work. The exchange boards have been doubled.

TOLEDO, O.—The Central Home Telephone Company of Kentucky, has acquired control of the Louisville Home Telephone Company, thus establishing the largest independent local and long-distance line in the country. The company has a capital of $1,300,000, and owns more than 1,000 miles of lines in southern territory, aside from the Louisville Home Telephone property. H.

SPRINGFIELD, O.—The American Automatic Telephone Company of this city has gone into the hands of a receiver. Judge A. H. Kunkle appointed A. F. Vance and T. A. Edmundson, of Urbana, to take charge of the property. The company was brought here as the result of local capitalists investing $250,000 in its stock. It is capitalized at $2,250,000, and James S. Brailey of Toledo, is its president. Assets are givgen at $142,653 while liabilities approximate $192,000. H.

ELECTRICAL SECURITIES.

On account of the fact that the Wall Street interests are awaiting a decision of the Standard Oil and the American Tobacco cases, there has been but little activity during the past week. The trading was, in fact, the dullest that it has been during the past year. The money market continues easy. There was an increase in activity in the bond market transactions, totaling $20,000,000 as compared with $13,000,000 in the previous week.

The Bell Telephone Company of Canada will shortly issue $1,250,000 five-per-cent bonds.

Western Union officials report twenty-five-per-cent increase in general business last fortnight. The day-letter service is meeting with great success.

At the annual meeting of the American Cities Railway & Light Company, S. Pfeifer was elected for a term of three years, and J. J. Manson for one year to succeed C. A. Coffin and Robert Jemison.

Chicago Railways earnings for January were $1,264,471, an increase of $273,688; for February $1,179,191, an increase of $265,716; first five days of March $211,389, an increase of $171,893. These large increases are due to absorption of Consolidated Traction lines.

Speyer & Company have purchased $1,846,000 consolidated mortgage five-per-cent gold bonds of the Havana Electric Railway due February 1, 1952. The proceeds of the issue will be used to redeem, at 110 and accrued interest, the present outstanding five-per-cent first-mortgage bonds. The bonds will be redeemed January 1, 1912, or earlier, at the option of the holder. Speyer & Company will place the new issue abroad.

President Baldwin, of the Otis Elevator Company, speaking of the earnings for the year ending December 31, 1910, said: "The volume of business was in excess of the previous year and profits were greater." The annual report, which will be given out at the stockholders' meeting on March 20, will show an increase of about ten per cent in net earnings, and it is expected that the surplus after interest charges and preferred dividends will be about three per cent above last year, when more than ten per cent was earned on the common stock.

DIVIDENDS.

Interborough Rapid Transit Company, quarterly dividend of two and one-quarter per cent, payable April 1.

Mexican Telephone & Telegraph Company; preferred semi-annual dividend of two and one-half per cent, payable May 1.

National Gas, Electric Light & Power Company; preferred quarterly dividend of one and one-half per cent, payable April 1.

New York Edison Company; regular quarterly dividend of one and one-half per cent, payable March 14.

Otis Elevator Company; annual dividend of four per cent on the common stock, comparing with three per cent annually for the last four years; payable one per cent quarterly; also regular quarterly dividend of one and one-half per cent on the preferred stock. The first installment of the common dividend and the regular preferred dividend are payable April 15 to stock of record March 31.

Safety Car Heating & Lighting Company; regular quarterly dividend of two per cent, payable April 1 to stock of record March 15.

St. Joseph Railway, Light, Heat & Power Company; regular quarterly dividend of one and one-quarter per cent on the preferred stock, payable April 1, 1911, to stockholders of record March 15.

West End Railway Company; regular guaranteed semi-annual dividend of $1.75 per share, payable April 1.

Western Union Telegraph Company; quarterly dividend of three-quarters of one per cent, payable April 15.

CLOSING BID PRICES FOR ELECTRICAL SECURITIES ON THE LEADING EXCHANGES AS COMPARED WITH THE PREVIOUS WEEK.

NEW YORK.

	Mar. 13.	Mar. 6.
Allis-Chalmers common	7⅞	7⅞
Allis-Chalmers preferred	30	30
Amalgamated Copper	62½	62
American Tel. & Cable	80¾	*82
American Tel. & Tel.	144½	144¾
Brooklyn Rapid Transit	76½	77
General Electric	147	147
Interborough-Metropolitan common	18⅜	18¼
Interborough-Metropolitan preferred	51	51
Kings County Electric	123	123
Mackay Companies (Postal Telegraph and Cables) common)	92¼	91¾
Mackay Companies (Postal Telegraph and Cables) preferred	74½	76
Manhattan Elevated	138⅞	138
Metropolitan Street Railway	*18	*18
New York & New Jersey Telephone	103	103
Pacific Tel. & Tel.	53	51⅞
U. S. Steel common	76⅛	75¼
U. S. Steel preferred	118	118
Western Union	71¾	73
Westinghouse common	66¾	67½
Westinghouse preferred	117	118½

*Last price quoted.

BOSTON.

	Mar. 13.	Mar. 6.
American Tel. & Tel.	144⅞	144½
Edison Elec. Illuminating	288	289
General Electric	149	147
Massachusetts Electric common	16½	17
Massachusetts Electric preferred	87	87
New England Teelphone	144	142
Western Tel. & Tel. common	20	20
Western Tel. & Tel. preferred	92	94½

PHILADELPHIA.

	Mar. 13.	Mar. 6.
American Railways	42½	43¾
Electric Company of America	12	12
Electric Storage Battery common	53½	53½
Electric Storage Battery preferred	53½	53½
Philadelphia Electric	16⅛	16⅛
Philadelphia Rapid Transit	19¾	20
Philadelphia Traction	86¼	85
Union Traction	47	47¾

CHICAGO.

	Mar. 13.	Mar. 6.
Chicago Railways, Series 1	90	90
Chicago Railways, Series 2	24	24½
Chicago Subway	4⅞	5
Chicago Telephone	119½	121
Commonwealth Edison	123	117¾
Metropolitan Elevated common	21½	21
Metropolitan Elevated preferred	66	67

PERSONAL MENTION.

GEORGE W. BISSEL, of Lafayette, Ind., has been elected superintendent of the electric light plant in Portland, Ind.

CALVIN WHITELY, JR., has returned to Baltimore, Md., to become assistant engineer of the United Railways and Electric Company.

J. B. DUKE has been elected president of the Greenville, Spartanburg & Anderson Railway, to take the place of W. J. Thackston, who resigned.

BELVIDERE BROOKS, general manager of the Western Union Telegraph Company, recently visited his old home, Waco, Tex., while on a tour of inspection in the Southwest.

SIR ROBERT HAMPSON, of Liverpool, is in this country in the interests of a British oil corporation owning wells in California, and will take up the question of applying electricity for pumping.

GEORGE A. CAMPBELL, research engineer with the American Telephone and Telegraph Company, will present before the Congress of Technology to be held in Boston April 10-11, a paper under the title, "Sinusoidal Oscillations."

CHARLES M. JACOBS, together with his corps of assistants, was given a dinner, on March 4, by the two hundred members of the Pennsylvania Tunnels Alumni Association of the North River division.

FRANCIS A. J. FITZGERALD, consulting chemical engineer, Niagara Falls, will present a paper on "An Electric Furnace for Zinc Smelting" before the Congress of Techonology to be held in Boston, April 10-11.

MOSES NELSON BAKER, editor of the *Engineering News*, delivered an address on March 17 at the Thomas S. Clarkson Memorial School of Technology. The occasion was the Charter Day exercises of the Fifteenth Anniversary of the institution and the subject of Mr. Baker's address was "The Engineer and Social Service."

E. A. WOODWARD, formerly with the United States Signal Corps, has accepted a position in the engineering department of the Chicago Telephone Company. During Mr. Woodward's connection with the regular establishment he carried on extensive experiments in telephony and telegraphy which particularly fit him for his new duties.

A. J. DE CAMP, one of the well known electric light men of the country, formerly vice-president of the National Electric Light Association, and who has been identified for a quarter of a century with the electric lighting interests of Philadelphia, is to take his first long vacation, and will spend the ensuing sixty days with Mrs. De Camp on the Pacific Coast.

W. J. TROTT of the Fostoria Incandescent Lamp Company, Fostoria, O., addressed the Kalamazoo branch of the Michigan State Society of Stationary Engineers, at its meeting on Saturday, February 25. Mr. Trott spoke on the use of electric lamps in industrial illumination. His talk was illustrated by stereopticon views, showing typical commercial installations of Fostoria lamps.

OBITUARY.

COL. JOSIAH C. REIFF, one of the pioneers of the financing of transcontinental railroads, died February 28, in New York. Colonel Reiff will be remembered as the man who supplied funds to Thomas A. Edison during the period of his early experiments.

JOSEPH WETZLER, president of the Electrical Engineer Institute of Correspondence Instruction, London, died in that city on February 22. Mr. Wetzler was born in Hoboken, N. J., and received his engineering education at Stevens Institute. On graduation he entered the Weston Works at Newark, but on account of his health took up editorial work with the *Scientific American*. Later he was associated with T. Commerford Martin on the staff of the *Electrical World*, leaving this to become editor of the *Electrical Engineer*. Mr. Wetzler was one of the oldest members of the American Institute of Electrical Engineers, and was at one time a vice-president of that society.

NEW PUBLICATIONS.

GEODETIC SURVEY REPORT.—The Coast and Geodetic Survey has published a bulletin in which are tabulated the results of observations made at the Coast and Geodetic Survey magnetic observatory at Cheltenham, Md., in 1907 and 1908.

MEXICAN ENGINEERING BULLETIN.—The Corps of Engineers of the Mexican Army is publishing a periodical bulletin of which six numbers have already appeared. The title is *Boletin de Ingenieros*. The February issue contains an article on marine steam turbines.

BULLETIN OF PURDUE UNIVERSITY.—Under the title "Purdue University, its Shops and Engineering Laboratories," the school has published an attractive pamphlet illustrating and describing its facilities and equipment. The book is well printed and attractively prepared and the large number of half-tone engravings that are used add largely to its interest.

REPORT ON TERRESTIAL MAGNETISM.—The Department of Terrestial Magnetism of the Carnegie Institution of Washington, tells of the work it has accomplished in a recent report. The work of securing the data for the lines of equal magnetic variation, which was done by the men on the yacht *Carnegie* is reviewed in an interesting way. Other land and ocean work which has been done is also mentioned and a map which is inserted shows a projected cruise of the *Carnegie*.

THE POSTAL TELEGRAPH.—*The Postal Telegraph*, a monthly magazine, published by the Postal Telegraph Company, for March, contains a number of very interesting contributions. This magazine is well edited and contains material of immediate interest to the employees of the company in every part of the country. The present issue is the twenty-seventh number, and it has been issued for over two years regularly each month. The staff is voluntary and the work is done entirely by the talented employees associated with the organization.

MINE RESCUE STATION.—The Report of the Mine Rescue Station Commission of the State of Illinois contains a description of the method of operating the rescue stations, of the station buildings themselves and of the rescue car. This report should be of especial interest at the present time because Illinois is the first state to undertake rescue work. The success of the work depends upon the co-operation of all interested in the mining industry and copies of the report will be furnished to those who desire it, so that they may see what has already been accomplished.

LEGAL NOTES.

INSPECTION-FEE CASE APPEALED.—The litigation which for some time has engaged the attention of the Toledo, O., courts, and through which that city has sought to enforce the payment of inspection fees amounting to nearly $4,000 from electrical contractors has been settled upon an amicable basis. In a test case in a test case in the Common Pleas Court the city ordinance was held unconstitutional and the cases were to have been appealed to a higher court. The settlement and the cases were to have been appealed to a higher court. The settlement was on a basis of fifty per cent of the fees claimed. A new ordinance has been passed correcting the defects pointed out by the courts. The amounts of settlements were as follows: Toledo Electric Company, $277.13;

R. H. Winters, $337.62; DeFrance & Straub, $328.12; J. J. Duck, $219.94; C. T. Groff Electric Company, $136.38; H. R. Fowler Electric Supply Company, $151.63; Silas Counter, $327.04; M. N. Hansen, $110.56. H.

PRESUMPTION OF NEGLIGENCE FROM ELECTROCUTION.—The city of Seattle owning and operating an electric power plant from which, under contract, it was furnishing current to one Abrams' house for illuminating purposes, the Supreme Court of Washington says that the city was under an implied contract to furnish the house, with light in the safest manner possible. Its duty was to protect Abrams and his family by exercising the highest degree of care, skill and diligence in its selection, construction, and maintenance of devices and appliances. Mr. Abrams was entitled to assume, when attempting to utilize the electric current in the customary manner, that he would not be subjected to personal injury or sudden death. When he did so attempt to use it and was electrocuted, a presumption of negligence on the city's part immediately arose. The fact of his injury was itself sufficient to constitute a prima facie case of the city's negligence. To say that his heirs or representatives could not recover damages until they affirmatively proved some specific act of negligence by a fair preponderance of the evidence might result in a denial of their right of recovery, no difference how negligent the city may have been. Current at a tension of 2,200 volts could not have passed through the body of Abrams without some negligence, mismanagement or mishap, which, under ordinary circumstances could only have been known to the party in charge of the system. The accident being shown, the burden devolved upon the city either to disclose a cause for which it was not responsible, or otherwise show that it was guilty of no negligence.—Abrams vs. City of Seattle, 111 Pac. 168.

PROPOSALS.

ELECTRICAL EQUIPMENT.—R. H. Thomas, school clerk, Portland, Ore., will receive bids until March 23 for the electrical equipment of the school buildings in that city.

POST OFFICE, MOUNT STERLING, KY.—The office of the Supervising Architect, Washington, D. C., will receive sealed bids until April 10 for the construction, complete (including plumbing gas piping, heating apparatus, electric conduits and wiring), of the United States post office at Mount Sterling, Ky., in accordance with drawings and specifications, copies of which may be obtained from the custodian of site or at the office of the Supervising Architect.

POST OFFICE, LAGRANGE, GA.—The office of the Supervising Architect, Washington, D. C., will receive sealed bids until April 20, for the construction, complete (including plumbing, gas piping, heating apparatus, and electric conduits and wiring), of the United States post office at Lagrange, Ga., in accordance with the drawings and specifications, copies of which may be obtained from the custodian of site at Lagrange, or at the Supervising Architect's office.

NEW INCORPORATIONS.

CHICAGO, ILL.—The Winter Battery Company has been incorporated with a capital of $10,000 by Hal C. Bangs, Harry Rubens, Jr., and Carey W. Rhodes.

NEW ORLEANS, LA.—The Burke Electrical Works Supplies has been incorporated with a capital of $15,000, by T. J. Burke, Otto T. Maier and J. H. Brady.

MILWAUKEE, WIS.—The Union Electric Manufacturing Company has been incorporated with a capital of $50,000 by Charles A. Rhine, Charles H. Keeney and John Rhine.

SOUTH BEND, IND.—The Arnold-Wagner Electric Company has been incorporated with a capital of $10,000. The incorporators are John W. Arnold, Jos. W. Wagner and W. H. Arnold.

BIRMINGHAM, ALA.—The Automatic Electric Railway Block Signal Company has been incorporated by a number of local business men. Dr. A. C. Foster is president of the company.

EVANSVILLE, IND.—The Evansville Marine Motor & Foundry Company has incorporated to manufacture engines, boilers and electrical machinery of all kinds. B. F. Durry, C. F. Donnelly and B. M. Mitchell are the incorporators. S.

INDIANAPOLIS, IND.—The Warren Electric & Machine Company has been incorporated with a capital of $10,000 to manufacture electrical machinery. The incorporators are E. P. Warren, H. W. McNaught and E. C. Strathmann.

BEDFORD, IND.—The Kenyon Searchlight Company has been incorporated to deal in electrical appliances. The capital is $15,000, and the incorporators are P. D. Metzger, Robert H. McKay, P. C. Stoller, E. L. Kechler and Ralph B. S. Keels.

BEDFORD, IND.—The Southern Equipment & Supply Company has incorporated to establish and equip a plant to manufacture all kinds of equipment and supplies for electric power, heating, light, gas and water companies. Horace C. Stillwell, C. B. Fletcher and Fred Riebel are directors. S.

DAYTON, O.—The National Electric Display Company has been incorporated with a capital of $10,000 to make and deal in electric advertising signs and display devices. The incorporators are E. P. Ridgeway, H. P. Williamson, F. P. Chamberlain, M. Le May and M. E. State.

INDIANAPOLIS, IND.—The Westerfield Gas Engine and Traction Manufacturing Company, capitalized at $50,000, has incorporated to do a general manufacturing business. Engines, traction machinery and electric supplies will be specialties. G. G. Westerfield and A. H. Nordyke are the incorporators. S.

NEW YORK, N. Y.—The interests of the Pay-As-You-Enter Car Corporation and the Pay-Within Car Company have been merged and a central organization to issue licenses under the patents owned and controlled by the two companies will be created under the title of Prepayment Car Sales Company, 50 Church Street.

SALT LAKE CITY, UTAH.—The American Electric Manufacturing Company has incorporated to engage in the manufacture of electrical fixtures and carry on a general electrical supply business. The capital stock is $5,000, and the officers are: R. L. Shannon, president; J. H. Cook, vice-president; H. L. Bouer, secretary and treasurer.

WEST ORANGE, N. J.—The National Phonograph Company recently filed an amended certificate changing the name of the company to Thomas A. Edison, incorporated. The stockholders are given as: Mina M. Edison, Ernest J. Berggren, Frank L. Dyer, who has been president of the Edison companies for the last three years; Carl H. Wilson, secretary; William Pelser and Harry F. Miller.

INDUSTRIAL ITEMS.

THE NEW YORK INSULATED WIRE COMPANY, New York, N. Y., has sent out blotters advertising rubber-covered wire and Competition wire tape.

THE SOUTHERN WESCO SUPPLY COMPANY, Birmingham, Ala., is mailing flyers advertising Emerson forge blowers and Emerson motors for sewing machines.

THE PACIFIC HEATING COMPANY, Ontario, Cal., due to the greatly increased demand for Hotpoint Irons, has found it necessary to double the size of its Chicago branch.

THE CHICAGO CARBON COMPANY, Chicago, Ill., recently distributed a pamphlet dealing with transmitter carbon materials. Several of the shapes of blocks, backs, etc., are illustrated.

THE W. H. ZIMMERMAN COMPANY, Chicago, Ill., has mailed post-cards illustrating the work being done on the hydroelectric plant of the Colorado River Power Company located at Marble Falls, Tex.

THE CONSOLIDATED ELECTRIC LAMP COMPANY, Danvers, Mass., has prepared a calendar advertising Champion "Class A" new incandescent lamps. This company is the largest independent manufacturer of "Class A" carbon lamps.

THE WESTINGHOUSE ELECTRIC & MANUFACTURING COMPANY, Pittsburg, Pa., has distributed through dealers a booklet entitled "Electric Meters: how to read them." The matter is explained in very simple non-technical language.

THE AMERICAN TRANSFORMER COMPANY, Newark, N. J., has published Bulletin No. 534, which deals with the subject of auto-transformers for low-voltage tungsten lighting. This company was among the first to prepare a complete line of small transformers for sign-lighting and house-lighting service.

THE CUTLER-HAMMER MANUFACTURING COMPANY, Milwaukee, Wis., has distributed a bulletin describing and illustrating the Thomas meter for indicating, integrating, or graphically recording the quantity of flow of gases (including air) at any temperature, independent of fluctuations of pressure or temperature.

THE HART MANUFACTURING COMPANY, Hartford, Conn., lists its complete line of "Diamond H" switches in a catalog which has just been sent to the trade. The new switch for hotel room lighting is among the various ones described, this being so arranged that when the door of a room is locked from the outside, the lights in the room are extinguished.

VERDON CUTTS & HOULT, Sheffield, Eng., have devoted a booklet to a description of the electrical manufacture of steel in the Verdon Cutts & Hoult Electro-Bessemer furnace. An illustration of a welding machine for iron and steel shows how this scheme is applied where welding is to be done.

THE LEEDS & NORTHRUP COMPANY, Philadelphia, Pa., recently issued Catalog No. 50, listing a complete line of portable testing sets and cable-testing apparatus. The sets are illustrated and prices and complete descriptions are given throughout. In the back of the publication there are listed a number of users of Leeds & Northrup cable-testing apparatus.

JAMES E. SOUTHARD & COMPANY, of Michigan City, Ind., cement contractors, have been awarded a contract by the Northern Ohio Power Company, at Akron, O., for 40,000 cubic yards of concrete work, including foundations, walls, floors, engine beds, roofs and a dam across the Cuyahoga River. The Southard Company will commence work about April 1, and expects to spend two years in finishing the work.

THE WILLARD STORAGE BATTERY COMPANY, Cleveland, O., is mailing bulletins No. 29 and No. 34. Bulletin No. 29 will be of especial interest to signal engineers as it describes in detail the construction of the Willard Planté plate. Bulletin No. 34 gives dimensions, capacities, etc., and shows illustrations of the assembled

batteries. The company states that there are now more than 100,000 Willard train-lighting cells in service.

THE FORT WAYNE ELECTRIC WORKS, Fort Wayne, Ind., has issued a small folder on the subject of bell-ringing transformers. These are made in several styles and voltages each of which is described. Two of the types are illustrated. The company has also distributed a small folder on sign and house-lighting transformers illustrating on the cover two signs which have been installed at Fort Wayne. This shows a comparison between the relative efficiency of low-voltage tungsten sign lamps and ordinary carbon lamps.

THE HABIRSHAW WIRE COMPANY, New York, N. Y.; has just closed a contract with the New York Edison Company to supply all the underground rubber-covered cable needed by this company for 1911, which is one of the largest orders of this kind that ever was placed. A contract has also been made for the same product with the Philadelphia Electric Company. The new Bankers' Trust Building and the new Vanderbilt Hotel, in New York City, are among the recent large buildings that have contracted for Habirshaw wiring throughout.

PAWLING & HARNISCHFEGER COMPANY, Milwaukee, Wis., announces that its president, A. Pawling, has gone with his family on an extended trip through the Southern and Pacific Coast states. He will return to Milwaukee next June. At a recent meeting of the board of directors of this company, S. H. Squier was elected a director and secretary of the concern; W. H. Hassenplug, sales manager, was elected a director and second vice-president, and F. P. Breck, who has been associated with the company for a number of years, was elected a director.

THE WESTINGHOUSE ELECTRIC & MANUFACTURING COMPANY, Pittsburg, Pa., received an order from the Rio de Janeiro Tramway Light & Power Company, Rio de Janeiro, South America, for two 2,500-kilovolt-ampere, 6,300-volt, three-phase, fifty-cycle turbo-generators. The Westinghouse Machine Company will furnish the turbines, which will be equipped with No. 11 Leblanc condensers. This equipment will be placed in a new station which will operate in conection with the power company's water power stations. The station will be located in the city and will be used only when the water is low and the water power plant cannot deliver its full rated capacity.

THE DIAMOND RUBBER COMPANY, Akron, O., has within the past month received visits from representatives of a number of the electrical jobbing houses that handle Diamond rubber-covered wires and cables. Almost without exception the visitors were considerably surprised and deeply impressed with the enormous size of The Diamond Rubber Company's factories; particularly that portion devoted to the manufacture of wire, which occupies one five-story building and portions of another. The visitors were shown what is probably the most complete and up to date line of rapid braiders and stranding machines, two enormous lead presses, and a factory working night and day.

THE STAVE ELECTRIC COMPANY, New York, N. Y., announces that its president, Theodore Stave, has recently returned from a trip to Europe, where he completed arrangements for acquiring the American rights for a 100 and 150-hour arc lamp from Tito Livio Carbona, a well known European inventor. The Continental rights for this lamp are controlled by the Allgemeine Elektricitäts Gesellschaft, which has lamps in satisfactory operation in Berlin, Potsdam, Frankfort, and other cities. These lamps, which are of the flaming-arc type, burn on either direct or alternating current, and give either a white or yellow light. The Stave Electrical Company keeps these lamps in stock.

THE GENERAL ELECTRIC COMPANY reports that owing to the remarkably good performance of the new CP-27 type air-brake compressors, it is experiencing a very large business in this line. Among the numerous large orders for these air brake equipments which have recently been received are the following: United Railways of San Francisco, eighty equipments; Oakland Traction Company, sixty equipments; Public Service Railways, Newark, N. J., 140 equipments; Springfield (Mass.) Street Railway Company, fifty equipments; Connecticut Company, New Haven, Conn., twenty equipments; Grand Rapids Street Railway Company, thirty-two equipments; Duluth Street Railway Company, nineteen equipments.

THE FEDERAL ELECTRIC COMPANY, Lake and Desplaines Streets, Chicago, Ill., on March 1 completed arrangements whereby the sale of goods manufactured by the Company will be handled exclusively by the Federal Sign System (Electric) as selling agents. The latter corporation has main offices at 501 Home Insurance Building, Chicago, and 229-231 West Forty-second Street, New York City, with branch offices in fourteen other large cities. The Federal Electric Company will, in the future, conduct the manufacturing end of the business exclusively. The Company will continue the manufacture of Federal signs, fixtures, supplies, vacuum cleaners, electric kitchen cabinets and other Federal specialties. This arrangement will greatly facilitate the handling of orders which can now be sent to the various branches of the Federal Sign System (Electric). The regular representatives of the Federal Electric Company will continue as agents of the Federal Sign System (Electric), and the selling force of the Federal Electric Company will be transferred to the selling corporation.

DATES AHEAD.

West Virginia Independent Telephone Association. Annual convention, Waldo Hotel, Clarksburg, W. Va., March 23 and 24.

American Supply and Machinery Manufacturers' Association. Annual meeting, Louisville, Ky., April 3, 4 and 5.

American Electrochemical Society. Annual meeting. Chemists' Club Building, New York, N. Y., April 6, 7 and 8.

Missouri Electric, Gas, Street Railway and Water Works Association. Annual meeting, St. Louis, Mo., April 13, 14 and 15.

Iowa Electrical Association. Annual meeting, Davenport, Iowa. April 19, 20 and 21.

Southwestern Electrical and Gas Association. Annual convention, Houston, Tex., April 27-29.

National Electric Light Association. Annual convention. New York City, May 29 to June 3.

Association of Railway Electrical Engineers. Semi-annual convention, Washington Terminal Station, Washington, D. C., June 16 and 17.

Mississippi Electric Association. Annual convention, Gulfport, Miss., June 20-21.

American Institute of Chemical Engineers. Semi-annual meeting, Chicago, Ill., June 21 to 24.

Association of Railway Electrical Engineers. La Salle Hotel, Chicago, November 6-10.

RECORD OF ELECTRICAL PATENTS.

Issued (United States Patent Office) March 7, 1911.

985,775. ATTACHMENT-PLUG. Tonjes August Carl Both, New York, N. Y., assignor to Ida S. Rosenheim, New York, N. Y. Filed Sept. 2, 1910. Consists of two insulating body parts and an insulating detachable cap, in the center of the body parts is a spring contact for the center plug contact, the entire arrangement being flexibly joined.

985,791. JUNCTION-BOX FOR SPARKING PLUGS. Jules Dubail, Delle, France, assignor to Société Industrielle de Delle, Delle, France. Filed June 1, 1910. Has an insulating spool-like body to whose center the wire is secured.

985,819. ELECTROMAGNETIC BRAKE. Joseph N. Mahoney, Wilkinsburg, Pa., assignor to Westinghouse Air Brake Co. Filed July 29, 1909. A brake for use with traction motors having regenerative control. In braking the field and armature of one motor are cross-connected to those of the other.

985,820. PARTY-LINE RINGING-KEY. Ray H. Manson, Elyria, Ohio, assignor to Dean Electric Co., Elyria, Ohio. Filed Sept. 17, 1909. Has a series of plungers arranged in a row and controlling spring contacts for separate ringing circuits.

985,821. ELECTRICAL TERMINAL CONNECTOR. Ray H. Manson, Elyria, Ohio, assignor to Dean Electric Co. Filed Nov. 17, 1909. A spring contact clip.

985,824. ELECTRIC TYPE-WRITING MACHINE. Andrew T. MacCoy, Dover, Mass., assignor to Charles B. Strecker, Brookline, Mass. Filed Oct. 15, 1907. A motor drives a type wheel under the control of keys, the wheel being turned in either direction through the smallest arc to get the desired character into position for printing.

985,838. AUTOMATIC ELECTRIC WELDING-MACHINE. Adolph F. Rietzel, Lynn, Mass., assignor to Thomson Electric Welding Co., Lynn, Mass. Filed Oct. 25, 1905. Combined with a current-supplying pressure contact is a work carrier, consisting of a link belt, the links of which are cut away to afford passage for the contact.

985,854. COHERER. William E. D. Stokes, Jr., New York, N. Y., and George W. Davis, Galilee, N. J., assignors to William E. D. Stokes, New York, N. Y. Filed Oct. 9, 1908. Consists of galena and arsenical copper ore elements, an iron box in which the same are housed, and means for adjusting the contact between the coherer elements.

985,858. RAIL-JOINT. William P. Thomson and Samuel G. Thomson, Philadelphia, Pa., assignors to Thomson-Thomson Co., Philadelphia, Pa. Filed July 15, 1910. An insulated rail-joint.

985,864. CONTROL-VALVE FOR WATER-JACKETED PUMPS. Walter V. Turner, Edgewood, Pa., assignor to Westinghouse Air Brake Co., Pittsburg, Pa. Filed Aug. 3, 1908. A motor-driven air compressor has an electrically controlled valve for

admitting cooling water to the compressor when the motor is started.

985,932. ELECTRIC-MOTOR REGULATION. Alphonse F. Pieper, Rochester, N. Y. Filed April 26, 1905. A regulating means for an alternating-current commutator motor interrupts the motor circuit when a certain speed is attained.

985,943. CIRCUIT-CONTROLLING APPARATUS. Joseph Sachs, Hartford, Conn., assignor of one-half to Hart Manufacturing Co., Hartford, Conn. Filed April 5, 1907. A rotary load switch is both manually and electrically controlled through a solenoid in a local circuit.

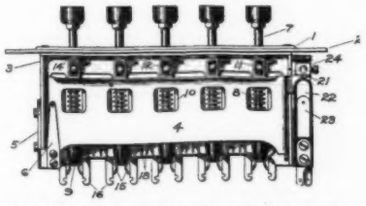
985,945. VACUUM-CLEANER. John Francis Shea, Philadelphia, Pa. Filed Dec. 23, 1909. An electric car is equipped with apparatus for suction cleaning of the street-car tracks.

985,951. BRUSH-HOLDER. Lorenzo H. Sparks, Warren, Ohio. Filed Feb. 5, 1910. The brush is completely insulated from the holder which carries an insulated stud to which a wire from the brush is secured.

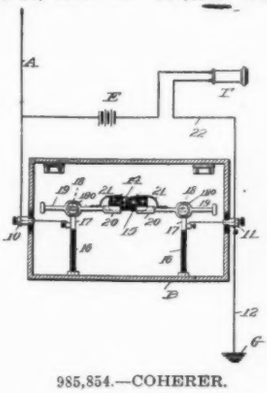
985,977. AUTOMATIC ELECTRIC RAILWAY-GATE. William J. Cook, Denver, Colo., assignor to Cook Railway Signal Co., Denver, Colo. Filed Nov. 5, 1909. The gate is automatically lowered and raised by the passing of an electric car, the operation being electrically controlled.

985,981. MAGNETO-DYNAMO ARMATURE. Richard H. Cunningham, New York, N. Y. Filed Dec. 30, 1909. Has an H-shaped magnetic core about the central web of which are bound both a primary and secondary winding.

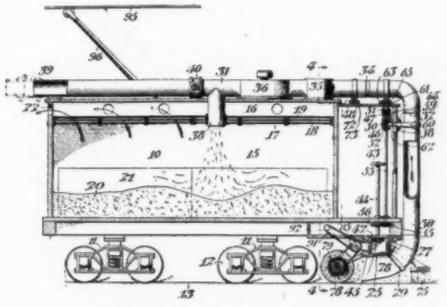
985,983. ELECTRIC HEATER FOR INCUBATORS, BROODERS, AND THE LIKE. Grant M. Curtis, Buffalo, N. Y., assignor to Cyphers Incubator Co., Buffalo, N. Y. Filed April 30, 1907. A



985,820.—PARTY-LINE RINGING KEY.



985,854.—COHERER.



985,945.—VACUUM-CLEANER CAR.

set of incandescent lamps is mounted on a plate within the incubator.

986,023. THERMOSTAT. Harry Y. Norwood, Rochester, N. Y., assignor to Taylor Instrument Co., Rochester, N. Y. Filed Nov. 29, 1909. A thermometer closes an electric circuit when the temperature reaches a definite point.

986,027. TROLLEY-HEAD. Alfred Shaver, Huntsville, Ala. Filed June 29, 1910. A flexible trolley-wheel mounting.

986,028. COMMUTATOR-TYPE DYNAMO-ELECTRIC MACHINE. William H. Singer, West Allis, Wis., assignor to Allis-Chalmers Co. Filed June 13, 1910. An armature winding with cross connectors has leads connecting the winding and commutator and a ring mounted on the latter for retaining the segments and supporting the cross connectors.

986,030. ROSETTE. James S. Stewart, New York, N. Y., assignor to Annie Stewart, New York, N. Y. Filed Oct. 5, 1909. Has grooves for the extension conductors and metallic clips for engaging the conductors.

986,033. INDUCTION-COIL. Richard Varley, Englewood, N. J., assignor to Autocoil Co. Filed May 8, 1909. The primary winding has an extra group of turns at one end of the coil adjacent to the make and brake device.

986,034. SAFETY-FUSE AND LINE-DISCONNECTING SWITCH. Sylvester B. Way and John L. Fay, St. Louis, Mo. Filed April 12, 1909. Terminal knife-blade contacts are mounted on an insulating block so as to permit replacing the fuse. The block is hinged so as to act as a switch.

986,037. ELECTRIC WATER-HEATER. Abraham Albert, San Francisco, Cal., assignor to Monarch Manufacturing & Supply Co. Filed May 21, 1910. Consists of a pair of cylindrical electrodes separated by a water-circulating space, all being attached to a handle for ready immersion in a vessel.

986,039. SYNCHRONIZING-INTERRUPTER FOR ELECTRIC CURRENTS. Emile Bachelet, New York, N. Y. Filed Feb. 4, 1909. A tensioned contact strip is set in vibration by an electromagnet.

986,045. MARKET-QUOTATION INDICATOR. William J. Chapman and William Robertson, Minneapolis, Minn. Filed July 1, 1908. Combined with an indicator having a dial provided with light compartments is an illuminated indicator wheel rotatively mounted in one of the compartments, an electrical controller for imparting step by step movement to the wheel, and lamp circuits having switches located at points remote from the dial.

986,064. ELECTRIC BATTERY. Carl Jager, Seattle, Wash. Filed July 13, 1910. A dry cell has a perforated felt blanket just inside the containing cell.

986,091. SYSTEM OF MOTOR CONTROL. William Siebenmorgen and Samuel H. Keefer, Plainfield, N. J., assignors to Niles-Bement-Pond Co., Jersey City, N. J. Filed Feb. 8, 1910. A shunt motor with a resistance in series with its field has a switch for normally short-circuiting this resistance. This switch is electromagnetically opened at the beginning of acceleration and closed at the end of this period.

986,138. INCANDESCENT-LAMP SOCKET. Leger J. Castonguay, Bridgeport, Conn., assignor to Perkins Electric Switch Manufacturing Co., Bridgeport, Conn. Filed Jan. 21, 1910. Comprises a switch block and a cam block mounted to turn together, contacts for the switch block and a spring to act on the cam block, and a key handle having a lost motion connection with said spindle.

986,179. ELECTRIC FURNACE. Charles Albert Keller, Paris, France. Filed Feb. 26, 1904. A plurality of hearths provided with vertical electrodes are connected to a central crucible. Two adjacent electrodes are connected to the positive pole of the generator while two on the opposite side are connected to th negative pole.

986,194. WATER-STERILIZING APPARATUS. Clifford D. Meeker, East Orange, N. J., and Charles Fred Wallace, New York, N. Y., assignors to Gerard Ozone Process Co., New York, N. Y. Filed Aug. 4, 1910. Has a tank containing oil, an ozonizer element submerged in oil, a transformer also submerged in the oil, and electrical connections from the transformer to the ozonizer element.

986,203. POWER-ARRESTER. John W. Novak, Pittsburg, Pa. Filed Feb. 21, 1910. A connector designed to insulate one section of a trolley wire from the adjacent section.

986,210. LEVEL-INDICATOR FOR BOILERS. Frank Pearson, Mount Rainier, Md. Filed Nov. 15, 1909. A float carrying an armature is moved in a vertical tube by changes in water-level. A solenoid surrounding the tube is thus raised and lowered, energizing various members of a set of contacts. The electric circuit can be made or broken by the movement of the solenoid.

986,216. LIFTING-MAGNET. Heinrich Poth, Wilkinsburg, Pa. Filed April 8, 1910. The armature is subdivided into a plurality of air gaps. These gaps being closed successively by the flux during the lifting period, each succeeding gap being reduced to the desired size to form the path of least resistance for the flux after the previous gap is closed.

986,240. TROLLEY. Frank Stone, Bradford, Pa. Filed June 9, 1909. Two springs acting directly on the trolley head serve to hold the wheel against the wire and to keep it in alinement at all times.

986,243. ALTERNATING-CURRENT ELEVATOR SYSTEM. August Sundh, Yonkers, N. Y., assignor to Otis Elevator Co., Jersey City, N. J. Filed Oct. 2, 1907. Combines with a motor, a reversing switch, a sectional starting resistance, and accelerating relays, a master switch comprising a lever movable from a central position in either direction, and controlling the circuits of the reversing switch magnets.

986,260. SELECTIVE LOCK-OUT TELEPHONE SYSTEM. Frank W. Adsit, St. Paul, Minn. Filed Nov. 17, 1909. Combines with a transmission line, a telephone, a party selector, a selector actuator and a magneto at each station, and electrical connections including the transmission line whereby electrical

impulses may be sent from a magneto at the calling station to the distant party selectors.

986,267. TELEPHONE-SIGNAL. Charles L. Chisholm, Marysville, New Brunswick, Canada. Filed Sept. 7, 1909. The telephone mouthpiece is used in place of a bell for attracting the attention of the called party.

986,274. LIGHT-FIXTURE. Morris F. Finkelstein, New York, N. Y. Filed Feb. 23, 1910. The shell of the fixture is extended above an inside sleeve to take up the slack of the conductor extending through the shell and the sleeve.

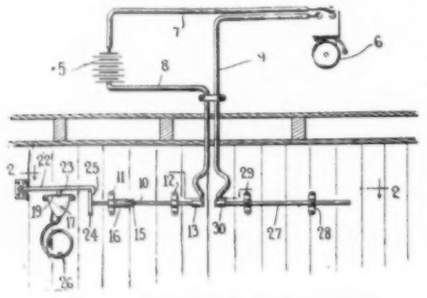
986,277. MOTOR-CONTROL SYSTEM. Ernest L. Gale, Sr., Yonkers, N. Y., assignor to Otis Elevator Co., Jersey City, N. J. Filed June 20 1910. The electric motor is provided with sectional starting resistance of relatively high temperature coefficients, and with electro-responsive accelerating devices. The increase in resistance of the starting sections facilitates their cutting out under load.

986,279. AUTOMATIC FIRE-ALARM. John W. Griffith, Greenfield, Tenn. Filed March 28, 1910. A bell circuit is held normally open by a trigger which is set free by the explosion of a mixture which is sensitive to heat.

986,281. CLOCK-OPERATED ELECTRIC SWITCH. Julius W. Hansen, Princeton, Ind. Filed Feb. 11, 1910. The switch is operated by means of a gear driven by the clock mechanism.

986,291. CONSTRUCTION OF COILS FOR ELECTRICAL APPARATUS. Gottlob Honold, Stuttgart, Germany, assignor to firm of Robert Bosch, Stuttgart, Germany. Filed Dec. 3, 1910. Each one of a number of groups of coils is held in an insulating trough of textile fabric.

986,299. MILEAGE COASTING-REGISTER FOR ELECTRIC CARS. Peter Lindemann, Westchester, and Edward B. Rich, New York, N. Y. Filed April 28, 1910. The register is thrown out of gear as soon as power is applied to the car, and put in gear when the power is thrown off.



986,279.—AUTOMATIC FIRE ALARM.

986,303. ELECTROPLATING-MACHINE. Constantine G. Miller, Chicago, Ill., assignor to Meaker Co. Filed Nov. 23, 1908. Embraces a tank adapted to contain an electrolyte, parallel conductors in the tank at each side, supporting hooks adapted to dip into the electrolyte between the conductors and hooks for disengaging the articles from the supporting hooks.

986,304. VACUUM-TUBE LAMP. Daniel McFarlan Moore, Newark, N. J., assignor to Moore Electrical Co., New York, N. Y. Filed Nov. 26, 1904. A vacuum tube containing a gas evolving organic substance is combined with a heating envelope surrounding the terminals and means for regulating the internal temperature of the envelope.

986,327. ELEVATOR-DOOR LOCK. Frederic E. Town, New York, N. Y., assignor to Otis Elevator Co., Jersey City, N. J. Filed May 31, 1906. A circuit-closer is operated by the elevator door so that the elevator is inoperative until the door is closed.

986,382. THERMAL CIRCUIT-CLOSER. Frederick C. Guptill, Elgin, Ill., assignor of one-half to William F. Lynch, Elgin, Ill. Original application filed Nov. 9, 1908. Divided and this application filed May 22, 1909. A themostatic ribbon is arranged so that with variations of temperature one of two will be forced into electrical connection with stationary contact points obtaining thus a rubbing contact.

986,383. LAMP-CORD ADJUSTER. William Hagstrom, Emanuel Hagstrom and Gustaf Hagstrom, Lindsborg, Kans. Filed June 14, 1909. A sheet metal bell contains a spring-actuated reel upon which the lamp cord is wound or from which it may be unwound as desired.

986,396. CABLE-TELEGRAPH APPARATUS. Isidor Kitsee, Philadelphia, Pa. Filed May 21, 1909. Combines a contact movable in response to line current, a series of contacts adapted to be swept over by the movable contact, a plurality of sources of energy controlled by the contacts, and means responsive to the change in relation of the sources for reproducing a signal.

986,400. TELEGRAPHIC-CODE CONCENTRATOR. Charles Wood McDonald, San Francisco, Cal., assignor to International Keycode Co., San Francisco, Cal. Filed April 1, 1908. Renewed Oct. 25, 1909. A cipher telegraph-code sheet arranged in a convenient manner.

986,405. TRANSMITTING APPARATUS FOR WIRELESS TELEGRAPHY. Peder Oluf Pedersen, Copenhagen, Denmark. Filed March 6, 1907. An oscillation circuit is adapted to produce oscillations continuously, an antenna circuit, a compensation circuit and a key being adapted alternately to connect the antenna and the compensating circuit to the oscillating circuit.

986,414. POWER-TRANSMITTING DEVICE. August Sundh, Yonkers, N. Y., assignor to Otis Elevator Co., Jersey City, N. J. Filed Oct. 24, 1907. The driving and driven elements are connected by flexible means, and means are furnished for preventing the independent rotation of the wheels in case of failure of the connecting element.

PATENTS THAT HAVE EXPIRED.

Following is a list of the electrical patents (issued by the United States Patent Office) that expired March 13, 1911:

516,188 ELECTRIC RAILWAY. Mark W. Dewey, Syracuse, N. Y.
516,204. MAGNETIZING COIL. John D. Ihlder, Yonkers, N. Y.
516,212. ELECTRIC PERFORATING PEN. Aaron D. Lewis, Canton, Mo.
516,213. ALTERNATING-CURRENT MOTOR. Robert Lundell, Brooklyn, N. Y.
516,217 RHEOSTAT. Herbert McNulta, Bloomington, Ill.
516,239. ELECTRICAL PROTECTION FOR SAFES. Charles F. A. Sturts, San Francisco, Cal.
516,240. ELECTRICAL PROTECTION FOR WINDOWS. Charles F. A. Sturts, San Francisco, Cal.
516,253. SECONDARY BATTERY. Edwin R. Whitney, Manchester, N. H.
516,263. ELECTRIC MOTOR. Oliver F. Conklin, Dayton, Ohio.
516,298. DYNAMO-ELECTRIC MACHINE. Frank J. Crouch, Portland, Ore.
516,312. PROCESS OF ELECTRIC METAL WORKING. Hermann Lemp, Lynn, and Walter S. Moody, Chelsea, Mass.
516,336. CAR-LIGHTING. Willard M. Miner, Plainfield, N. J.
516,337. METHOD OF AND APPARATUS FOR FORMING GRIDS OR PLATES FOR SECONDARY BATTERIES. John M. Pendleton, New Brighton, N. Y.
516,341. SAFETY DEVICE FOR ELECTROSTATIC MEASURING INSTRUMENTS. William E. Ayrton and Thomas Mather, London, England.
516,343. ELEVATOR. John W. Blake and Francis H. Lacey, Kansas City, Mo.; George H. Blake, administrator of said John W. Blake, deceased.
516,374. CLOSED-CONDUIT ELECTRIC RAILWAY. Frederick L. King. Chicago, Ill.
516,379. SWITCH FOR SECONDARY BATTERIES. Hermann Muller, Nuremberg, Germany.
516,478. ELECTRIC LOCK. John R. Donnelly, Fairfield, Mo.
516,484. REGULATING SOCKET FOR INCANDESCENT LAMPS. Morris D. Greengard, St. Louis, Mo.
516,487. ELECTRIC CURRENT-REGULATOR. Charles D. Haskins, Brooklyn, N. Y.
516,492. ELECTRIC TROLLEY DEVICE. Charles Knapp, St. Louis, Mo.
516,495. SYSTEM OF CAR LIGHTING, HEATING, ETC. Isaac N. Lewis, Fort Wadsworth, N. Y.
516,496. CAR LIGHTING. Isaac N. Lewis, Fort Wadsworth, N. Y.
516,497. SELF-REGULATING DYNAMO. Isaac N. Lewis, Fort Wadsworth, N. Y.
516,498. ELECTRIC SWITCH. Isaac N. Lewis, Fort Wadsworth, N. Y.
516,500. ELECTRO-MECHANICAL GONG. Morris Martin, Malden, Mass.
516,506. INTERIOR TELEPHONE SYSTEM. Thomas McCoubray, New York, N. Y.
516,508. ELECTRIC HEATER. Jeremiah O'Meara, New York, N. Y.
516,516. ELECTRIC MOTOR FOR STREET CARS. William Baxter, Jr., Baltimore, Md.
516,524. SUSPENDED ELECTRIC FAN MOTOR. Julian F. Denison, New Haven, Conn.
516,552. TELEGRAPH APPARATUS. Josiah A. Parker, St. Louis, Mo., and Leland L. Summers, Chicago, Ill.
516,553. ARMATURE FOR DYNAMO ELECTRIC MACHINES OR MOTORS. William B. Sayers, Glenwood, Bearsden, Scotland.
516,565. ELECTRIC RAILWAY SUPPLY SYSTEM. James F. Cummings, Detroit, Mich.
516,574. ELECTRIC ARC LAMP. Fred L. McGahan, Indianopils, Ind.
516,596 and 516,598. ELECTRICAL RAILWAY SIGNAL. Ira L. Green, Kittanning, Pa.
516,626. CLOSED-CONDUIT ELECTRIC RAILWAY. Edward H. Brown, Salem, Mass.
516,631. CLOSED CONDUIT FOR ELECTRIC RAILWAYS. William Lawrence, New York, N. Y.